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Important Books Received

The physiology of oral hygiene and recent research, with special reference to accessory food factors and the incidence of dental caries. By J. Sim Wallace, D.Sc., M.D., L.D.S., Lecturer on Preventive Dentistry, King's College Hospital; formerly Dental Surgeon and Lecturer on Dental Surgery and Pathology, London Hospital. *Second edition.* 1929: pp. 228; 6¼ x 3¼ in.; seven illustrations. Baillière, Tindall and Cox, 7 and 8, Henrietta St., Covent Garden, London, England.

Christian and Jew. A symposium for better understanding. By thirty-six contributors; edited by Isaac Landman. 1929: pp. 374; 6¼ x 3½ in.; 37 illustrations (portraits). Horace Liveright, New York.

An outline of oral surgery for the general dental practitioner. By James L. Zemsky, D.D.S., Attending Oral Surgeon to the Midtown Hospital, New York. 1930: pp. 171; 6 ¼ x 4 in.; 116 illustrations; $4.50. Physicians and Surgeons Book Co., Brooklyn, N. Y.

Oral diseases: a practical treatise offering diagnostic and therapeutic aid to the practitioner of medicine and dentistry. By James L. Zemsky, D.D.S., Attending Oral Surgeon to the Midtown Hospital, New York. 1930: pp. 402; 6¼ x 4 in.; 414 illustrations; $8.00. Physicians and Surgeons Book Co., Brooklyn, N. Y.

Necrotic gingivitis (trench mouth). By Harold Keith Box, D.D.S., Ph.D., Research Professor of Periodontology, Faculty of Dentistry, University of Toronto. 1930: pp. 64; 7 x 4½ in.; 18 illustrations. University of Toronto Press, Toronto, Canada.

Medical education and related problems in Europe. By Willard C. Rappleye, Director of the Study by the Commission on Medical Education. 1930: pp. 200; 7¼ x 4 in.; no illustrations. Published by the Commission, 215 Whitney Ave., New Haven, Conn.

Those teeth of yours. By J. Menzies Campbell, L.D.S., D.D.S., F.R.S.E., F.I.C.D., Fellow of the Royal Society of Medicine. 1929: pp. 141; 5½ x 3½ in.; 17 illustrations; 3/6 net. William Heinemann, Ltd., 99, Great Russell St., London, W.C.I., England.

Infant nutrition. By Williams McKim Marriott, B.S., M.D., Professor of Pediatrics, School of Medicine, Washington University. 1930: pp. 375; 7¼ x 4¾ in.; 55 illustrations; $5.50. C. V. Mosby Company, St. Louis, Mo.

Rickets including osteomalacia and tetany. By Alfred F. Hess, M.D., Clinical Professor of Pediatrics, University and Bellevue Hospital Medical College, New York City. 1929: pp. 485; 7¼ x 4 in.; 52 illustrations; $5.50. Lea and Febiger, Philadelphia, Pa.

Synopsis of the practice of preventive medicine as applied in the basic medical sciences and clinical instruction at the Harvard Medical School. By the Faculty of Medicine. 1929: pp. 194; 6½ x 3¾ in.; no illustrations. Harvard University Press, Cambridge, Mass.

The properties and uses of drugs. By Henry H. Rusby, Ph.M., M.D., D.Sc., Dean and Professor of Materia Medica, College of Pharmacy, Columbia University; A. Richard Bliss, Jr., A.M., Phar. D., M.D., Dean of the School of Pharmacy, and Chief of the Division of Pharmacology and Materia Medica, Colleges of Medicine and Dentistry and School of Pharmacy, University of Tennessee; and Charles W. Ballard, A.M., Phar. D., Ph.D., Associate Professor of Materia Medica and Director of the Microscopical Laboratory, College of Pharmacy, Columbia University. 1930: pp. 823; 7¼ x 4¾ in.; 38 illustrations; $6.50. P. Blakiston's Son and Co., Philadelphia.

American illustrated medical dictionary. A complete dictionary of the terms used in medicine, surgery, dentistry, pharmacy, chemistry, nursing, veterinary science, biology, medical biography, etc. By W. A. Newman Dorland, A.M., M.D., F.A.C.S., member of the Committee on Nomenclature and Classification of Diseases, American Medical Association, and Editor of the "American Pocket Medical Dictionary"; with the collaboration of E. C. L. Miller, M.D., Professor of Bacteriology and Biochemistry, Medical College of Virginia. *Fifteenth edition.* 1929: pp. 1427; 8¼ x 4¾ in.; 525 illustrations; flexible binding—plain, $7.00; thumb index, $7.50. W. B. Saunders Company, Philadelphia and London.

Dental bibliography. A reference index to the literature of dental science and art as found in the Libraries of the New York Academy of Medicine and Bernhard Wolf Weinberger. Compiled by Bernhard Wolf Weinberger, D.D.S., Librarian of the First District Dental Society; Advisory Librarian, Dental Library, New York Academy of Medicine. *Second edition.* 1929: pp. 183; 7¼ x 4½ in.; no illustrations. Published under the auspices of the First District Dental Society of the State of New York, New York City.

Deutsche Zahnheilkunde. Heft 75. 1929: 8 x 4½ in.; marks 3.60. Georg Thieme, Leipsig, Germany. (1) Submaxillare Röntgenaufnahmen, ein neues Verfahren zur röntgenographischen Darstellung des Unterkiefers und seiner Zahne. By Dr. J. v. Reckow, Marburg. Pp. 15; 30 illustrations. (2) Klinik und Diagnostik der Osteodystrophia fibrosa localisata der Kiefer. By Dr. Karl Spring, Vienna. Pp. 15; 7 illustrations.

Fundamentals of pathology. By Joseph Schroff, B.S., M.D., D.D.S., Associate Professor of Oral Pathology, School of Dental and Oral Surgery, Columbia University. 1929: pp. 109; 7¼ x 4½ in.; 40 illustrations; $2.50. William Albert Broder, New York City.

Outline of bacteriology. By Henry A. Bartels, B.S., D.D.S., Lecturer on Bacteriology, School of Oral Hygiene, Columbia University. 1929: pp. 128; 6¾ x 4 in.; 47 illustrations; $2.00. William Albert Broder, New York City.

Dental histology and embryology. By B. Orban, M.D., Professor of Dental Histology and Pathology, Chicago College of Dental Surgery, Dental Department of Loyola University. *Second edition.* 1929: pp. 218; 7 x 4¼ in.; 201 illustrations; $4.00. P. Blakiston's Son and Co., Inc., Philadelphia.

Practical conclusions from scientific research in denture construction. By Alfred Gysi, D.D.S., M.D. (hon.), D.M.D. (hon.), Professor of Prosthetic Dentistry and Director of the Histological Laboratory, University of Zurich, Switzerland. 1929: pp. 40; 7¼ x 4¼ in.; 37 illustrations. Dentists' Supply Company of New York.

The business side of dentistry. By Edwin N. Kent, D.M.D., Lecturer on conduct of practice, Harvard University Dental School. 1929: pp. 180; 6¼ x 4 in.; 13 illustrations; $5.00. C. V. Mosby Co., St. Louis, Mo.

A text-book of oral pathology for students and practitioners of dentistry. By Russell W. Bunting, D.D.S., D.D.Sc., Professor of Dental Histology and Pathology, University of Michigan, Ann Arbor, Michigan. 1929: pp. 495; 7¼ x 4¼ in.; 327 illustrations; $7.00. Lea and Febiger, Philadelphia, Pa.

Hygiene of the mouth and teeth. By Thaddeus P. Hyatt, D.D.S., F.A.C.D., Professor of Preventive Dentistry, New York University Dental School, and Assistant Medical Director, Metropolitan Life Insurance Company. 1929: pp. 64; 4½ x 2¾ in.; 1 illustration. Brooklyn Dental Publishing Company, Brooklyn, N. Y.

THE PROBLEM OF THE PULPLESS TOOTH, AS SEEN BY CLINICAL AND LABORATORY INVESTIGATION[1]

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I. INTRODUCTION

Many volumes have been written on the problems presented by the pulpless tooth. Some of the writers have voiced the opinion that such a tooth is *always* a menace to health, and therefore have favored the removal of teeth so involved. Others have ardently contended that *some* pulpless teeth may be retained without danger. It is now my privilege to submit material in support of the claim that it is logical, in properly selected cases in which there is a degenerative change surrounding the root-end, to expect a satisfactory recovery following proper treatment. What I consider to be "proper treatment" will be referred to very briefly, as this subject may be best discussed in detail in connection with a clinic.

There are two lines of laboratory research by which we may attack the problem; namely, bacteriology and pathology. Bacteriological evidence has been presented in support of the contention that root-ends of pulpless teeth harbor pathogenic bacteria, and therefore are likely to favor the formation of metastatic foci. We must consider such statements in the light of the fact that the removal of a tooth from its socket, without contamination, is a very difficult and a seldom-accomplished task. Also, it does not follow that an infected area can

[1] Read at a meeting of the First District Dental Society of the State of New York, Academy of Medicine, December 10, 1929.

be treated only by excision or amputation of the part. By the pathologic or histopathologic method we study the tissue, following its removal from the body, both in the gross specimen while still fresh and after preparation for microscopic inspection. By this method it is possible not only to study the cellular reactions within the peridental membrane and pulp canals which were present at the time of removal, but equally as well, especially in the hard tissues, the records there of what happened around the root-end and within the canal shortly after treatment. Then too, by collecting radiograms of the cases taken at intervals following treatment, the pathologic method enables the investigator to correlate the histologic studies with the radiographic studies, thereby very materially increasing his ability to evaluate x-ray findings of future clinical cases, as well as his ability to give a more accurate prognosis. It is for these reasons that I have confined most of my researches to the pathologic method, supplemented by radiograms, case histories, and clinical examination.

II. ROOT-END DEGENERATION

It is our opinion that certain cases with pathologic root-ends may be satisfactorily handled through the root canal. A few cases may be controlled by root filling, followed by amputation of the root-end and curettement of the diseased tissue. Many others must be treated by extraction. Below I briefly classify the degenerative changes, and then attempt to suggest which offer the most favorable prognosis when considered purely in the abstract.

1. Acute apical abscesses:
    - A. Following an acute suppurative pulpitis. Radiographic evidence may be negative.
    - B. Acute exacerbation of a previous chronic condition. Radiographic evidence positive.
2. Simple granuloma:
    - A. Without root-end resorption.
    - B. With root-end resorption.
3. Liquefaction necrosis—sinus present; or, with history of periodic discharge and partial healing-over on surface, if there is easy drainage through canal, sinus may not develop.

A. Without root-end resorption.
B. With root-end resorption.

4. Root-end cyst—the result of a former infection. Sometimes called infection cyst.

The last mentioned condition—cyst—is never recommended for root-canal treatment without immediately afterwards employing root amputation. The simple acute abscess offers an excellent prognosis, especially if the case is seen early enough to prevent much tissue destruction. Likewise cases of a chronic nature which flare into the acute stage are easily controlled under the same provision. The exacerbation appears to act as a stimulant to the defensive mechanism, which of course favors healing.

Simple dental granulomata, considered separately, will heal when the bacteria, toxins, necrotic material, etc., have been removed and the canal filled or the tooth extracted. It is important in this regard to determine whether a portion of the apical cementum is necrotic. Repair cannot be expected to take place in the presence of such a condition. This is a most difficult phase in diagnostic procedures. However, as a general rule, when a correctly focused radiogram reveals much roughening of the root-end, a case does not have a favorable prognosis. This diagnostic sign is of much more importance than the size of the radiolucent area. What has been said concerning the indications for treatment of apical granulomata applies equally well to cases of liquefaction necrosis. The chief difference between these two conditions is found in the limiting membrane of the granuloma and the marked tendency toward dissolution of tissue in the liquefaction necrosis, which is due to proteolytic enzymes.

III. HEALTH PROBLEMS

It is not sufficient to concern ourselves with the tooth alone. We must evaluate the local findings in terms of the general physical condition. It is not thought to be good practice to retain a tooth with a diseased root-end under the following conditions:

1. When there is danger of secondarily involving the maxillary sinus.
2. When the tooth does not occupy a strategical position in the arch.
3. When the patient is suffering from conditions that may arise

from foci of infection, but only after all other possible sources have been considered. It is folly to remove a focus in the mouth and leave another in the appendix, fallopian tube, tonsil, etc.

FIG. 1. Cross section through simple dental granuloma. × 78

4. When the patient is already carrying an overload, such as active tuberculosis, diabetes, etc.

5. When the patient has reached an age at which reparative processes have been materially retarded.

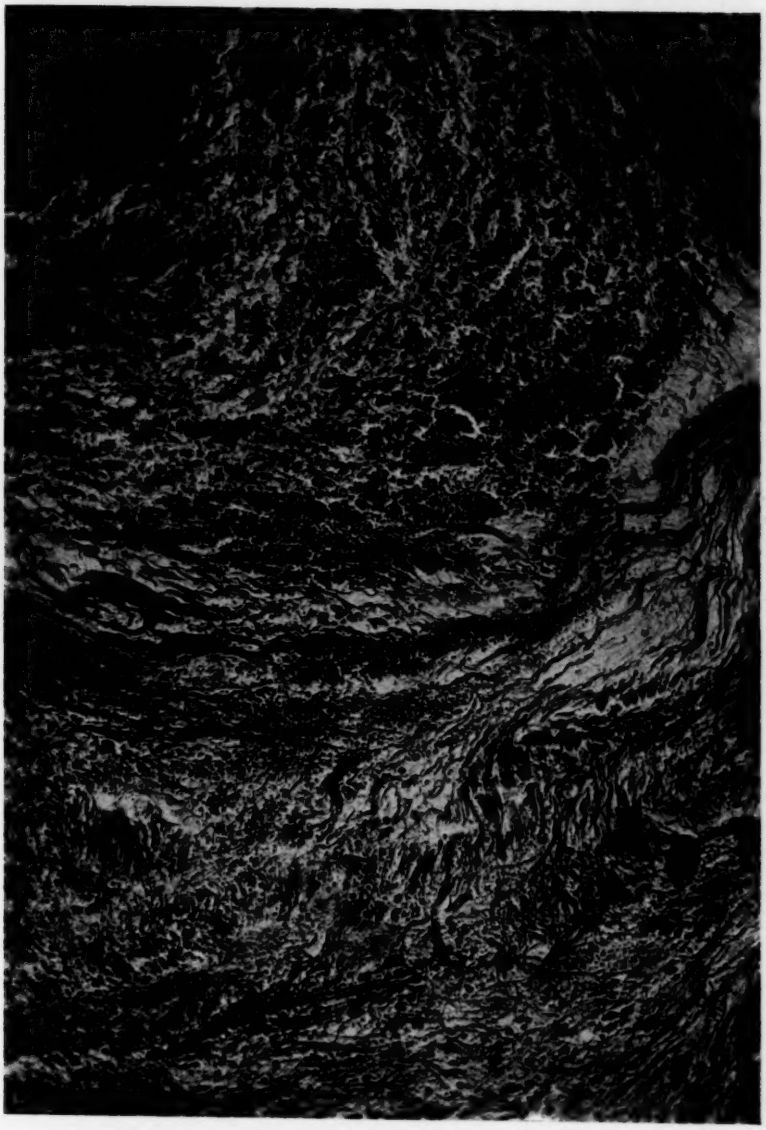

FIG. 2. Higher power of encapsulating wall of granuloma shown in *fig. 1*. × 155

FIG. 3

FIG. 4

FIG. 5

FIGS. 3 AND 4. Radiograms of lower molar under treatment. Note areas surrounding both mesial and distal roots. These would check closely with *fig. 1*, if examined histologically

FIG. 5. Repair rapidly progressing in remains of granuloma formerly surrounding distal root in *figs. 3* and *4*. Note extensive vascularization and development of young fibrous tissue in central mass of granuloma. × 78

6. Any other condition in which the patient's susceptibility to infection is increased—anemia, leukemia, etc.

For many years we have been carrying on treatment of root-end degenerations in cases selected as previously suggested, frequently

FIG. 6. High power of area "×" in *fig. 5*. × 300

checking the results by clinical and radiographic examination; and, whenever the opportunity presented, by microscopic study. We believe it is conservative to say that approximately 70 per cent of such cases yield to treatment. The accompanying photomicrographs are presented in support of this statement.

FIG. 7

FIG. 8

FIG. 9

FIG. 10

FIG. 7. Radiogram of case taken immediately after root filling in 1918

FIG. 8. Radiogram of same case in 1919

FIG. 9. Radiogram of same case in 1928

FIG. 10. Photomicrograph of apical foramen of upper second bicuspid shown in *figs. 7, 8,* and *9*. Record of resorption and rebuilding found in hard tissues. Soft tissues in canal, and periodontal membrane, are free from inflammatory reaction. × 78

Fig. 1 is a cross-section of a typical dental granuloma, attached to the apex of a lower molar, in which the apical cementum was not necrotic. This represents a case which would have been satisfactory for treatment. The canal had been filled to mid-root, but the apical

FIG. 11. Taken from slightly higher level than previous photograph. Marked rebuilding of calcified structures. Soft tissue is free from inflammation. × 150

portion contained operative debris, necrotic pulp tissue, and masses of polymorphonuclear leucocytes. Observe that the center of the mass is composed of leucocytes, but does not show signs of nuclear fragmentation. Also note the layer of fibrous encapsulation. *Fig. 2* is a higher magnification through the encapsulating wall.

Fig. 3 shows the condition of a lower first molar (of a young lad) that was accepted for treatment. There is an extensive involvement of both root-ends. After root-treatment, the patient did not return for nearly a year, when we found that caries had destroyed nearly the

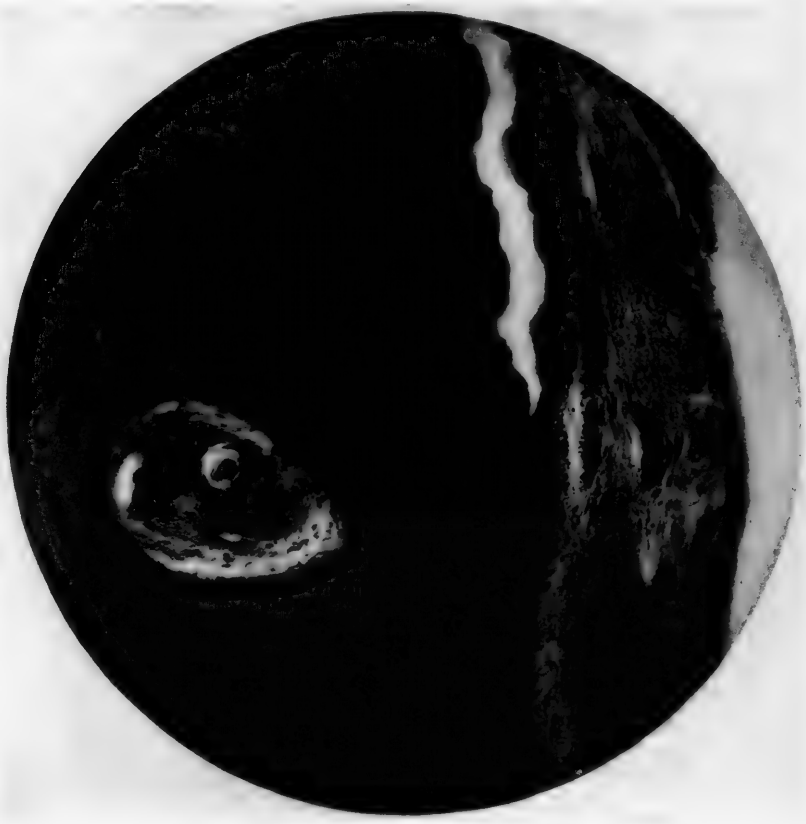

FIG. 12. Canal completely enclosed within root. × 150

entire crown; also that the areas surrounding the distal root-end had disappeared, while that about the mesial root-end was larger (*fig. 4*). The roots were extracted and the tissue fixed for histologic study. On examination of the gross specimen, we found a very tiny mass of soft

tissue about the end of the distal root, which was firmly adherent; also a mass of tissue considerably larger about the mesial root. The mesial root-end was roughened; the distal root was smooth and normal in contour. *Fig. 5* is a cross section of the tiny mass attached to the

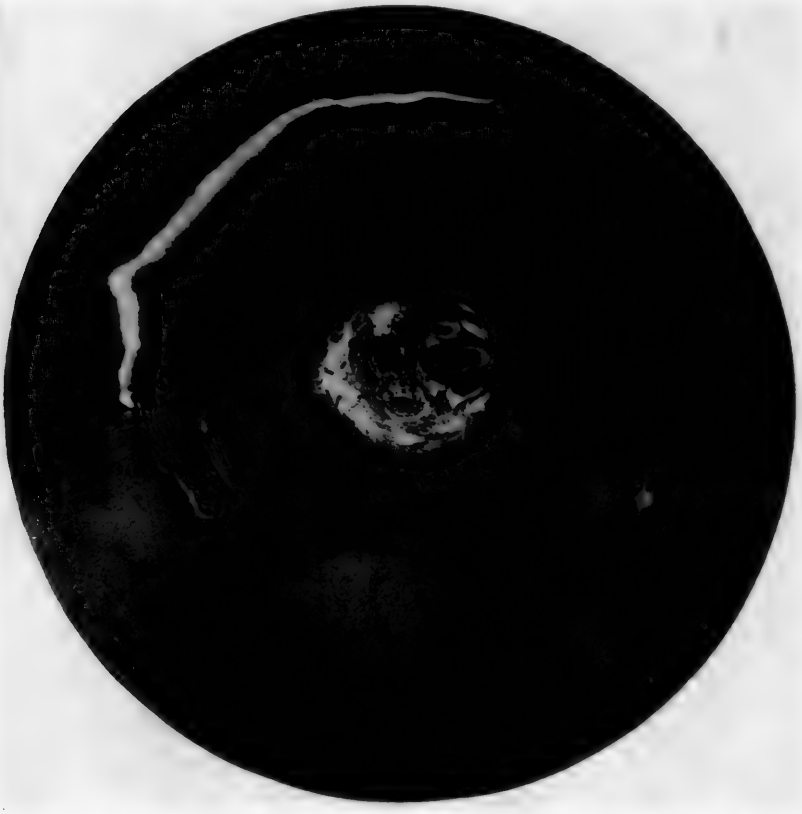

FIG. 13. Midway between apex and level of root filling. Extensive repair has taken place. × 150

distal root one year after treatment of the root-canal. There is a decided change from the condition shown in *figs. 1* and *2*. The central mass is undergoing fibrosis; the area has become vascularized, and fibroblasts are present everywhere. *Fig. 6* is a higher magnification

of the area marked "X" in *fig. 5*. I present this case to illustrate the process by which a granuloma may heal; also to call attention to the fact that, unless one is careful to obtain a full history of a case that has been previously treated by another operator, one may condemn a con-

FIG. 14. Calcification and fibrosis at level of root-canal filling. No evidence of inflammatory reaction. × 150

dition which is really showing marked improvement and needs only time for a complete repair.

With this as a background we will now consider the clinical, radiographic, and histologic evidence of a case under my personal observa-

tion for ten years. The patient, a woman about thirty presenting in 1918, had necrotic pulps in the upper right first and second bicuspids, with a definite apical involvement about each root-end that was diagnosed as a simple granuloma. The treatment consisted of the routine curettement of necrotic material from the canals, medication, and filling with gutta-percha points, all of which was done in accordance with accepted surgical principles. *Figs. 7, 8* and *9* portray the radiographic findings at the time of root-canal filling; and one year, and ten years, after treatment, respectively. *Fig. 10* is a photomicrograph of the second bicuspid at the level of the foramen. The surrounding periodontal membrane, and the tissue within the foramen, are free from inflammation. There is a record of a previous resorption of hard tissue, and a subsequent repair by a tissue not unlike cementum. *Figs. 11, 12, 13,* and *14* are taken from respectively higher levels of the canal. Each records a process of resorption and rebuilding in the hard structures, and a healing in the soft tissue by fibrosis, with sufficient vascularization.

It is possible to submit similar evidence of many cases, but such a repetition would add nothing substantial to the argument. The essayist has so recently presented to New York societies similar data, upon the reactions in the apical region following the removal of vital pulps, that it is unnecessary to describe this work.[2]

IV. CONCLUSIONS

From the study of many cases, examined in ways similar to the one described above, we conclude:

1. The finding of certain degenerative processes about a root-end does not always indicate extraction.

2. In many such conditions repair promptly takes place following judicious treatment, and the tissues remain in a satisfactory condition for years.

3. Root-canal treatment will succeed only when the general practitioner is willing to adopt a method in accord with the biologic forces involved. Until such a condition is generally achieved, we shall continue to hear many more or less just criticisms of pulpless teeth.

[2] Blayney: Tissue reaction in the apical region to known types of treatment. *Journal of Dental Research*, 1929, ix, p. 221.

SOME FOSSIL TEETH OF SHARKS FROM THE CAPE PROVINCE OF SOUTH AFRICA

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INTRODUCTION

Towards the close of 1929, Dr. Raymond A. Dart, Professor of Anatomy at the University of the Witwatersrand, brought to one of us a collection of fossilised teeth of sharks which, through his instrumentality, were very generously presented to this Department for description by their owner, Mr. Wade, of Cradock in the Cape Province. We learned that these teeth had been unearthed, at a vertical depth of 30 ft., in the Bathurst area of the Cape Province, some 100 miles from the town of Cradock, and about 30 miles inland from Port Alfred.

In a letter to the writers, Dr. S. H. Haughton, Curator of the South African Museum, Cape Town, states that, in this area, a number of teeth (of fossil sharks) have been obtained hitherto from the Tertiary deposits. According to the same authority, it has been found possible to identify the following species: Carcharadon megalodon, C. auriculatus, Odontaspis elegans, Lamna compressa, Isurus hastalis, and I. sillimani.

It is with much hesitation that we have ventured to identify and draw up a description of the fossil teeth now discovered. Paucity of literature and comparative material, doubts concerning present opinions regarding the detailed characters of the teeth of some of the less well known fossil sharks, and lack of data concerning the variations of form in the teeth occurring in the various positions in the mouth of the same species, have made the investigation one of considerable difficulty. Nevertheless, since records of the discovery of fossil teeth of sharks in this country are practically non-existent, the present report would appear to be warranted.

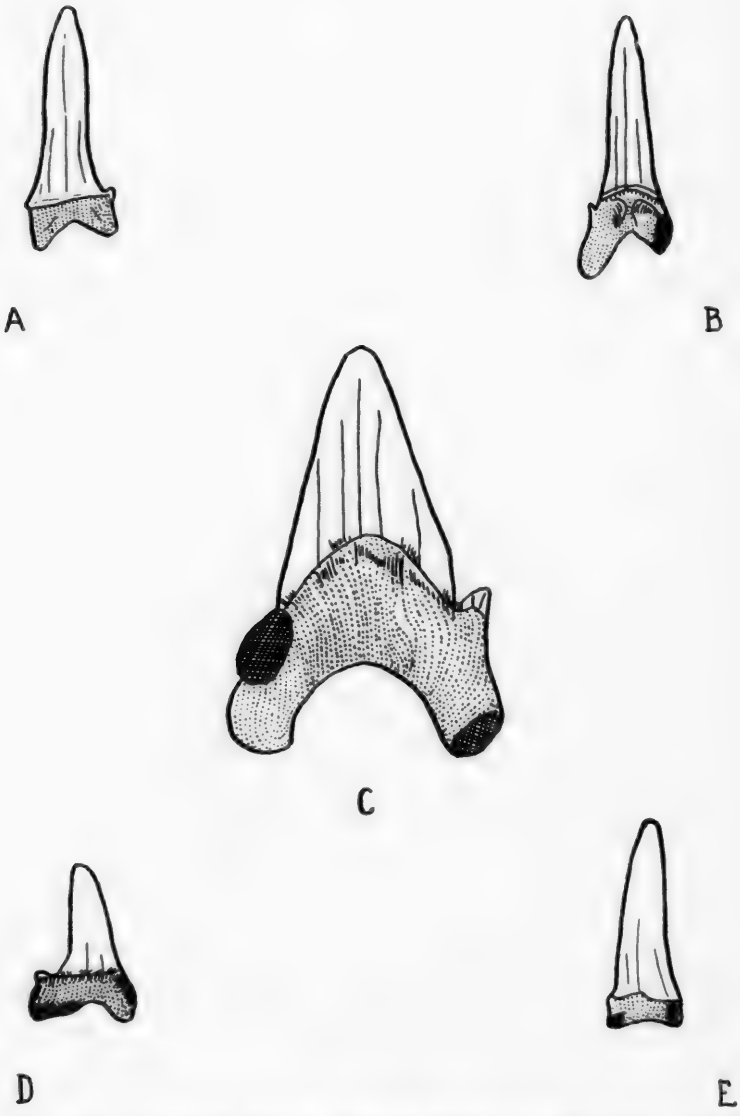

FIG. 1. Diagram of fossil teeth of Odontaspis elegans (*A*). The same from the back (*B*). Lamna (Otodus) appendiculatus (*C*). Lamna (Otodus) compressa (*D*). Odontaspis constrictus (or Isurus—suggested by Haughton—*E*). Discovered in the Bathurst area, Cape Province, South Africa.

MATERIAL

The collection consists of over fifty teeth. With few exceptions, the teeth are in good condition, the great majority retaining the most important part for purposes of identification—the base.

It is considered that at least four and possibly five or six species of shark are represented in this collection. The majority of the teeth are of the Odontaspid type; one species being closely allied to if not identical with the Odontaspis elegans of the Eocene of Maryland, while another appears to be markedly similar to Odontaspis constrictus. A few species are referable to the genus Otodus—possibly O. compressa, O. minutus, and O. nanus. The following arrangement of species must, however, be regarded as provisional:

Odontaspis elegans. Of this species, there are two teeth extremely well-preserved, and these were used for purposes of identification. In the collection, there are some half-a-dozen other teeth which most likely belong to this group, but damage to the bases has rendered them unsuitable for exhaustive investigation.

Odontaspis constrictus. The specimens relegated to this species number over a score. While some of them appear to be slightly damaged and unsuitable for identification purposes, the majority of them agree closely with Odontaspis constrictus. It is to be noted with interest that this species was also markedly represented in the remains of the sharks found by Mr. Kaye and Mr. Cunliffe in the Pondicherry Beds and reported on by Sir Philip Grey Egerton (*Proc. Geo. Soc.* 1845).

Otodus (*Lamna*). This genus is well represented by some half-a-dozen large teeth. Comparing the teeth with the figuring at our disposal, we are able to trace a fairly close agreement with the following species:

Otodus compressa
Otodus nanus
Otodus appendiculatus

Age. As there was, at the time of the unearthing of these fossils, no one at hand to take an interest in the geological aspect of the discovery, we are unfortunately quite unable to produce anything in the nature of an authoritative statement on this point. In view, how-

ever, of the species of shark to which the specimens belong, the former discovery of similar species in the same area, and the nature of the deposits in the Bathurst area, it seems probable that the assemblage are of early Tertiary, probably Eocene, Age.

In conclusion, we wish to acknowledge the valuable assistance afforded us by Dr. S. H. Haughton in identifying the specimens.

INTERNATIONAL ASSOCIATION FOR DENTAL RESEARCH

Scientific Proceedings of the Chicago Section[1]
May 8, 1930

STANLEY D. TYLMAN, B.S., D.D.S., M.S., F.A.C.D., *Editor*

Meeting held at the Medical and Dental Arts Club, 185 N. Wabash Ave., Chicago, May 8, 1930. *Chairman:* Edward H. Hatton, B. L., M.D., President of the Section.

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Abstracts

I. THE SO-CALLED NASMYTH'S MEMBRANE

Rudolf Kronfeld, M.D., Chicago College of Dental Surgery, Loyola University, Chicago, Ill.

There is a great diversity of opinion on the structure and formation of Nasmyth's membrane. Some authors described epithelial cells in the membrane; others found it homogeneous without cells. The specimens of the earlier investigators were obtained by dissolving the enamel of extracted teeth in acid and studying the residual film under the microscope. Often, by this method applied to younger teeth, some of the epithelial attachment connected with the enamel surface was seen under the microscope and described as Nasymth's membrane.

Since we have learned about the existence of an epithelial attachment on the enamel, the discordant findings are no longer misunder-

[1] The last preceding series of abstracts of the proceedings of the Chicago Section was published in the *Journal of Dental Research,* 1930, x, p. 247.

stood. The stage of tooth eruption determines whether the structure that was formerly described as Nasmyth's membrane contains epithelial cells or is merely a homogeneous cuticle.

II. PYORRHEA AS THE CLINICIAN SEES IT

G. R. Lundquist, D.D.S., Northwestern University Dental School, Chicago, Ill.

The clinical picture considers the life history of the individual. The microscopic analysis of the histopathologist fits into the picture as a cross-section of a very short period in the history of the case, and is never a final analysis in that it never indicates what the end result would have been had treatment been instituted at a favorable time. The microscopic section, like the radiograph, should portray change over a period of time, but this it cannot do, because the life history of the case it pictures is at an end.

Histologists have pictured the normal investing tissues of the teeth as an investment of the root and the gingival portion of the crown of the tooth. Considering the normal as persisting throughout life, they did not realize that a tissue subject to inflammatory process and partial recoveries therefrom would, during a lifetime, show changes that clinicians have regarded as normal adjustment processes. These are expressed as recessions, or normal adjustments, made by a living organism. This failure of the histopathologist, to note these obviously normal adjustments on nature's part, has given rise to the multitude of magical pyorrhea cures now on the market, aiming at reattachment of the detached tissues by attempting to duplicate, in middle aged and elderly people, normals of ages twenty to thirty, rather than a control expressed as a recession, which would be the product of the variety of masticatory effort under our present civilization.

Because the dentist is not acquainted with the course of untreated diseases, he cannot therefore realize that magical tooth pastes, mouth washes, and the like, are psychological measures to induce cleanliness in the mouth. They are better mental stimuli than oral ones. That is where the former concept of the histopathologist left him. He resorted to magic to restore in the mouths of middle aged people the normals of youth. On the basis of the clinician's analysis, the dentist

would have been content with a recession when controlling an inflammatory or infectious process, as is the case elsewhere in the body, when nature is again in control.

III. A CASE OF BONE HAEMANGIOMA

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The haemangioma is a fairly common tumor and is probably always congenital, even though it may not appear at birth. It is distinctly a tumor of the soft parts. There are very few recorded cases of haemangioma of bone. This case, therefore, is presented purely as a case report and because of its great rarity.

The patient, a lad of twelve years, presented with a large bluish-colored soft mass in the lower left jaw, in the position of the premolars and first permanent molar. The bone was invaded and destroyed to about one-half the depth of the mandible. The microscopic findings are as follows: On one side of the section, there is stratified squamous epithelium. The supporting tissue is very vascular, containing large vascular spaces. In other places, there are hemorrhagic areas. The tissue is infiltrated with lymphoid cells.

IV. FINDINGS IN RELATION TO RESORBING DECIDUOUS TEETH

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Three things were shown which seem to have received little consideration in studies of the resorbing deciduous teeth; namely, proliferation of the epithelial attachment along the root surface, recession of the gingivae, and lengthening of the clinical crown. Rather widespread and severe damage, often accompanied by infection, occurs in the gingivae and in the enamel epithelium of the permanent tooth through prolonged retention of the deciduous fragment.

V. DISCUSSION OF "THE SHIFTING EPITHELIAL ATTACHMENT"

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(The author prefers not to publish an abstract at this period in his work.)

VI. REACTION OF RAT TISSUE TO IMPLANTED ROOT APICES

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In this study, rats were used to determine the reaction of tissue to the apices of normal healthy teeth, infected teeth, and pulpless teeth showing a lack of radiographic evidence of disease. Immediately following extraction, the root-ends of the teeth were implanted in the legs of rats. Careful surgical procedure was employed to avoid infection, both in the removal of the teeth and in their implantation. After a period of six weeks to two months, the tissue was sectioned.

The root-ends of the *normal* teeth were found to be imbedded in the rat tissue without evidence of inflammation. The rat tissue in a number of cases had replaced the pulp tissue in the pulp canal; and where a fracture had occurred in the tooth structure, the rat tissue grew into it—further evidence of lack of infection. The apices of the *infected* teeth disclosed an entirely different reaction. Inflammation was present at the root-end, and small pieces of infected filling material were surrounded by highly infiltrated tissue. In the *pulpless teeth showing no evidence of infection*, the reaction simulated the normal healthy root-end. The rat tissue was in close approximation with the gutta-percha filling-material and with the cementum. This condition was true on both the apex and the fractured surface of fragments in a number of cases. The lack of inflamed rat tissue about these fragments is evidence that the pulpless tooth, if not infected, was tolerated by the rat tissue equally as well as a normal tooth.

PHYSICO-CHEMICAL STUDIES ON THE STRUCTURE OF DENTAL ENAMEL. II. A QUANTITATIVE METHOD FOR DETERMINING RELATIVE DIFFERENCES IN THE PERMEABILITY OF THE TEETH[1]

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I. INTRODUCTION

A previous communication[1] presented evidence indicating that the enamel of a dog canine may be considered a permeable membrane. This evidence consisted of electro-endosmotic, osmotic, and membrane-potential determinations. All three types of evidence indicate that enamel is a structure having the permeability of what Michaelis would call "large pored" collodion membranes. As there pointed out, a study of potential differences that arise across a membrane, when it separates two salt solutions of different concentrations, throws considerable light upon the structure and properties of the membrane. Many membranes appear to retard or prevent movement through them of ions of one electrical sign, while permitting passage of ions of the opposite sign. As a result of this selective permeability, measurable potential differences arise. Membranes having relatively large pores give rise either to no membrane potentials or to very slight ones. Membranes having very small pores prohibit the entrance of certain ions because of electrostatic forces in the pores, and give rise to potentials of considerable magnitude.

[1] The first study was published by Klein, H., and Amberson, W. R.: *Journal of Dental Research*, 1929, ix, p. 667.

An ideal membrane, which prohibits entirely the penetration of one ion of a bathing salt solution, gives rise to a maximum membrane-potential. The value for such a potential difference across an ideal membrane,[2] at 20°C., is 0.058128 volt. When a membrane is so set up that the salt solution inside is ten times more concentrated than that bathing the outside, the ensuing EMF has been termed by Michaelis the Co.P of the membrane. The Co.P for an ideal membrane as described above is then 0.058128 volt at 20°C. If a membrane gives a Co.P value lower than this, the membrane is more permeable than the ideal structure, since magnitude of Co.P is dependent upon the selective permeability of the structure for ions. The determination of Co.P, whether the membrane is egg shell, skin, collodion, frog skin, enamel, etc., gives an index of the permeability of the structure. A Co.P close to 58 millivolts indicates a membrane that is only slightly permeable; lower values show greater permeability. Very small EMF values for Co.P indicate a relatively permeable structure.

In a study of the influence of various diets on teeth of swine, it was desirable to determine quantitatively a possible effect on the porosity of tooth structure. Histological evidence[3] indicates that, in animals on deficient diets, tooth structure is inferior to that in control animals—there is delayed and defective calcification of the enamel and dentine. The question arose: do the teeth in animals on deficient diets have a greater permeability than the normal? To obtain the answer, Co.P determinations were made on both types.

II. EXPERIMENTAL

Right central incisors from groups of control and deficient swine were extracted, cleansed of all bone and soft tissue, sawed through at the enamelo-cemental junction, and the roots discarded. The crowns were thoroughly washed in distilled water, and the enamel surfaces cleansed with a small tooth brush. Each incisor crown was given a number, and placed in an individual test tube in 0.1 *M* KCl for 48 hours. The latter procedure permits the crown to become thor-

[2] Clark: Determination of hydrogen ions, p. 303; Williams and Wilkins Co., Baltimore, Md,

[3] Unpublished findings by the author.

TABLE 1

Table showing determinations of membrane potentials (Co.P) across central incisor crowns of pigs on control or deficient diets. Temperature 25°C. Co.P for ideal membrane, at 25°C., 0.05912 volt

Pig No.	Age *days*	Polarity: inside	Polarity: outside	Membrane potential *volt*	Calomel electrode readings[1] *volt*	Co.P[2] *volt*
Control diet						
9960	299	−	+	0.02952 0.03226 0.03276	0.009 inside outside + −	0.04051
5280	126	−	+	0.02973 0.03772 0.04410	0.009 inside outside + −	0.04618
9963	292	−	+	0.04702 0.04705	0.00205 inside outside − +	0.04498
5251	234	−	+	0.05445 0.05525	0.00205 inside outside − +	0.05280
Low calcium-high phosphorus diet						
5285	105	−	+	0.01853 0.01906 0.01907	0.009 inside outside + −	0.02822
5206	104	−	+	0.02235 0.01678 0.02028	0.009 inside outside + −	0.02880
5286	125	−	+	0.02455 0.02375 0.02587	0.009 inside outside + −	0.03372

[1] The difference in potential between the calomel electrodes without the crown in the circuit is *added* to the Co.P reading, when inside is minus and outside is plus. When inside is plus and outside is minus, the calomel electrode reading is *subtracted* from the Co.P readings.

[2] The Co.P values are averages of the individual determinations of membrane potential.

oughly impregnated with KCl. Into the dentine of each crown, a small cavity was drilled with a fissure bur. The drilling was so controlled as to make each cavity in each crown the same size. The teeth were then returned to their respective test tubes, and allowed to remain in 0.1 *M* KCl. The Co.P was determined in the following manner: Each crown was adjusted in an apparatus identical with that shown in Figure 1 of the earlier paper,[4] with 0.1 *M* KCl inside the cavity in the dentine and 0.01 *M* KCl outside the crown. EMF was measured with a type-K Leeds and Northrup potentiometer. A capillary electrometer was used as a null instrument.

III. RESULTS

Right central incisor crowns from animals on control and deficient diets gave Co.P values that differed significantly in their magnitude. The teeth from control animals gave in general higher Co.P readings than teeth from animals on deficient diets, as shown in *Table 1*.

Since the magnitude of Co.P is dependent upon the efficiency of the membrane as an ionic sieve, and since Co.P magnitude is greater the more impermeable the membrane and smaller the more permeable the membrane, the determinations herein described, although few in number, seem to indicate that central incisor crowns from pigs on calcium-deficient diets are more permeable than central incisor crowns from animals on control diets.

IV. SUMMARY

1. A quantitative method to express permeability differences in teeth is presented.

2. With this method central incisor crowns from pigs on deficient diets gave smaller Co.P values than those from control animals.

3. Comparison of the Co.P values indicates that the crowns from animals on deficient diets were more permeable than those from control pigs.

[4] Klein and Amberson: *Loc. cit.*, p. 669.

DENTAL MORPHOLOGY AND PATHOLOGY OF PREHISTORIC GUAM[1]

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[1] Presented at a session of the Eighth General Meeting of the International Association for Dental Research, Royal York Hotel, Toronto, Ontario, Canada, March 24–26, 1930. See abstract: *Journal of Dental Research*, 1930, x, p. 415. Published in the *Memoirs of the Bernice P. Bishop Museum* (Honolulu), 1929, xi, p. 255 (no. 3).

I. INTRODUCTION

This study is based on the examination of crania from Guam in the Bernice P. Bishop Museum. I am indebted to the Director and members of the Museum staff for permission to examine the collection, and for facilitating the work. The collection was made in January, 1922, by Dr. J. C. Thompson and Mr. H. G. Hornbostel, officers in the United States Navy. Guam is an insular possession of the United States. From the stratigraphical and cultural evidence the crania are of a pre-Spanish or early post-Spanish epoch. For the most part the skulls are a homogeneous lot, probably indicating inbreeding. Guam was discovered by Magellan in 1521; it is the principal island of the Marianne group comprising part of Micronesia. Early in the Spanish régime not only were many of the indigenous males killed, but foreign male strains—Spanish, Mexican, Filipino, Chinese—were intruded. Consequently, the present inhabitants, known as Chamorros, are of mixed racial origin.

Guam food complex

The food habits, including the chewing of narcotic plants, are inextricably correlated with the dentition of any people. Therefore, some notes on the food complex of the Mariannes are included. The ancient Chamorros subsisted exclusively upon the flora and fauna of their insular habitat. Safford (9) has made extensive observations on the flora and people of Guam. From him the following notes are taken. The food of the aborigines consisted of fish, some fowl, bread-fruit, taro, yams, rice, bananas, coconuts, and, in times of scarcity, nuts of *Cycas circinalis*, which were not edible until leached and cooked. For relishes the screw pine and sea-weeds were utilized. Rice was cultivated and sold. They regarded it as a luxury and kept it for their feasts. Bread-fruit was cut into thin slices and dried. It could be kept for a long time. Taro was not made into poi, as in the Hawaiian Islands.

Fish were caught in great quantities at certain periods, dried in the sun, and stored for future consumption. They did not eat eels. Cannibalism was not practised. Indeed, the early navigators said the Chamorros could not be induced to eat meat of any kind. Al-

though they had pigs at a very early date, it is probable that these were introduced after the discovery. The only mammals in prehistoric times were two species of bats, which doubtless were not utilized as food. The Chamorros had fowls and kept doves in captivity, but there is no evidence that they ate them. Few articles of their food could be eaten raw. As was the universal custom throughout the tropical Pacific, they cooked in pits in the earth in which they built fires and heated stones, then made alternate layers of food, leaves, and heated stones. They did not eat to excess, nor did they use wine or other intoxicating liquor. Water and the milk of unripe coconuts were their only beverages.

Betel nut chewing

Of narcotics Safford (10) in another treatise says: "The nut used is from the betel palm, *Areca catechu*; a part of the nut is wrapped with a few leaves of betel pepper, *Piper betle*, and the whole sprinkled with a pinch of lime, the latter secured by burning coral. The betel thus prepared has an agreeable aromatic pungency, not unlike that of nutmeg. It imparts a fragrance to the breath, which is not disagreeable, but it discolors the teeth in time and causes them to crumble away, while the constant expectoration of saliva, red like blood, is a disagreeable habit. The aborigines were remarkably free from disease and physical defects, and lived to a great age."

The betel juice is the active agent in the production of the red color which stains the saliva and mouth of the betel chewer. The color may be readily obtained by mixing the betel nut and lime in rain water. It has a marked stimulant effect. The quid is habitually held in the buccal recess, between teeth and cheek. Safford (10) writes that "every native carried a finely woven bag of Pandanus matting containing betel nut." The custom of betel chewing was universal, and has survived to the present day, though the habit is now less popular. There are many references to the habit. Thus, a succint example from Freycinet's (1) voyage states that "the complexion of both sexes is a dark yellow. Their teeth are in general spoiled by the use of betel, and the lime with which they season it."

The habit of betel chewing, as well as many other cultural elements, spread from India to Malaysia and the Pacific. The Chamorros

were not far removed from the Philippines, where betel chewing, and blackening and mutilating the teeth, are practised. The two latter practices are evident in this collection. From Kroeber's (6) handbook we note: "The overwhelming majority of Philippine tribes agreed with their kinsmen of the East Indies in filing and blackening the teeth." "Betel is chewed. It irritates the gums, turns the saliva blood red, and blackens the teeth. The essential element is the nut of the areca palm, which is sliced, sprinkled with lime, and wrapped in a leaf of buyo."

An interesting comparison of this oriental narcotic habit, with the use of narcotic plants mixed with lime by other primitive peoples, is pertinent. Safford (11) again is authority: "Specimens of *Erythroxylon coca* were found in coca bags suspended from the necks of Peruvian mummies. All were accompanied by small gourds containing lime, and a spatula by means of which the lime was dipped out. In place of lime, wood ashes were sometimes used. The use of lime or ashes to set free the alkaloid contained in the leaves recalls the same custom in connection with the betel of Asia, the piptadenia snuff, and green tobacco of the Aztecs. That its efficiency should have been independently discovered by the primitive inhabitants of such widely separated regions is remarkable." Kroeber (5) describes an analogous habit of mixing lime with a narcotic as practised in aboriginal California, where tobacco, which was cultivated, was mixed in small mortars with lime obtained by burning mussel shells. This mixture was chewed or made into a concoction and swallowed. This habit may have been derived remotely from Mexico. These narcotic-lime chewing habits are apparently authentic cases of cultural parallelism. Comparison of the dentitions of crania from these diverse regions shows betel chewing to result in far greater deleterious effects on the teeth than do the other narcotic-lime habits: permanent discoloration and heavy lime accretions, with resultant pathological processes are produced (*v. infra*, alveoloclasia). Safford's remark that the habit causes the teeth "to crumble away" should not be taken literally.

II. MORPHOLOGY

Physical anthropology embraces the study of racial anatomy, physiology, and pathology. Dr. Hrdlička defines physical anthropol-

ogy as the study of man's variation. Dental anatomy, comprising both maxillae and teeth, varies considerably in human races. The comparative study of anatomical features is properly referred to as morphology. Many features of the dentition may be observed for comparative purposes. In this study but a few have been selected: some, standardized measurements; others, such as the enamel line at the cervix, comparatively recent observations.

Cervical enamel line

The marginal line of the enamel on post-cuspid teeth of most Caucasians pursues a fairly horizontal course around the cervix. I have elsewhere (7) described a marked deviation from this regular course on the teeth of several American tribes: the enamel streams into the radical bifurcation, both facially and lingually, to an acute point; and on some there is even a marked root-wise extension of the enamel on single-rooted premolars. On the molars of the Eskimo there is frequently a detached enamel-pearl nestled in the bifurcation about 1 mm. beyond the acute point of the marginal line. Chappel (2) has shown that 94 per cent of Hawaiian skulls examined by him evidence some indication of enamel extension. From these observations it would appear that this morphological feature is worthy of note for comparative purposes.

On the teeth of this Mongoloid tribe I found the enamel streaming into the bifurcations, particularly of the inferior second and third molars, but to a shorter distance than with the Americans. I found few enamel pearls. The degree to which the enamel extended root-wise was arbitrarily classified as follows, and per cent of occurrence noted: marked, 4; medium, 16; slight, 62; absent, 18. Thus 82 per cent of the Chamorros' crania evidence a root-wise extension of the cervical enamel line.

Horizontal enamel grooves

A peculiar feature of these teeth is a corrugation of the enamel on the facial aspect of the superior premolars and molars, more constant on the latter. At first I considered the feature a variant of hypoplastic enamel of individual significance only; but, upon closer inspection, the structure of the enamel appears sound, without faults or atypical

pigmentation. The feature is often obscured by the stain and lime accretions concomitant with betel-nut chewing. The corrugation consists of a horizontal, rounded, unfaulted groove at about the vertical center of the crown with more or less of a bulging ridge above and below. No. 760 presents a good example of this corrugation on the superior first and second molars. This feature is so constant throughout the group that I am forced to conclude that corrugation of the facial aspect of the enamel of the superior molars is a morphological character. In some skulls on both superior and inferior molars, there are roundish nodules on the cervical border of the enamel as well as the grooves and elevations. This is a fairly common feature and is exemplified in No. 662.

Marginal ridges of incisors

The marginal ridges on the lingual aspect of the superior central and lateral incisors vary in prominence with racial groups. In anthropological literature this character is referred to as the shovel-shaped teeth of Hrdlička. Dr. Hrdlička found the superior incisors of the American Indian to be characterized by triangular fossae on their lingual aspect, formed by convex elevated marginal ridges and cingulum. Sullivan (13) has featured this dental character under the following classification: absent, slight, medium, marked. The marginal ridges of the incisors of this Mongoloid tribe were not prominent. *Table 1* summarizes the occurrence of this character.

Cusps

The cusp pattern of molars is a feature having a distinct bearing on racial relationship. The dentition of lower races of mankind differs from that of the higher in that the cusp pattern is constant in the former: the superior molars are quadricuspid; the inferior, quinquecuspid. Thus the cusp formula for the lower races tends to be $\frac{4\text{-}4\text{-}4}{5\text{-}5\text{-}5}$. In modern Caucasians the superior third molar varies widely in cusp form, and the inferior second molar usually has but four cusps, but the inferior third molar varies. Owing to both ante- and post-mortem loss of teeth, such morphological features cannot be observed in the total number of crania studied.

Frequently there are accessory cusps, which are possibly more distinctive of the higher races. One such accessory cusp has a fairly distinct form and location; namely, on the lingual aspect of the mesiolingual cusp of the superior first molar. This coalesced element is

TABLE 1

Marginal ridges of incisors (per cent)

	ABSENT	SLIGHT	MEDIUM	MARKED
Central	84	12	4	0
Lateral	72	8	17	3

TABLE 2

Cusps on M_3

CUSPS	SKULLS	PER CENT
4	66	81
4.5	4	5
5	11	14
Mean 4	Total 81	100

TABLE 3

Cusps on molars

Crania Molar	88 M^1	88 M^2	46 M^3	82 M_1	81 M_2	56 M_3
Cusps	Per cent					
5			7	100	14	34
4.5	10		2		5	5
4	90	69	30		81	59
3.5		22*	30			
3		8	20			
2.5		1	2			
2			9			

* One with an additional Carabelli cusp.

known as the accessory cusp or tubercle of Carabelli. In this group of 106 crania the first molars were observable in 89; and this tuberculus anomalous was present in approximately 12 per cent. Its occurrence was bilateral on the first molars in eight skulls, unilateral in two, and

bilateral on the second molar in one. Of the eleven individuals eight were females, three males.

The cusp form of the inferior second molar merits separate note in the somatological study of any racial group. In the Chamorros it is quadricuspid in 81 per cent, and tends to be quinquecuspid in 19 per cent. *Table 2* gives the complete data.

The number of cusps on all molars present was recorded. The superior third molar is the most variable; the inferior first molar

TABLE 4

Diminutive teeth

Superior		*Inferior*	
Third molar	7		
Small Teeth			
Third molar	7	Third molar	2
Second molar	2	Second molar	2

TABLE 5

Large teeth

MUS. NO.	SEX	SIZE	MISCELLANEOUS
477	Male	Large	M_3 impacted, bilateral
529	Male	Large	Bifurcated roots, Simian jaws
614	Male	Large	
646	Male	Broad incisors	Bifurcations, supernumerary tooth
770	Male	Large	Malocclusion
763	Male	Broad incisors	M_3 impacted, unilateral

is constant. From the data in *Table 3*, it is apparent that the cusp formula for this group tends to be $\frac{4\text{–}4\text{–}4}{5\text{–}4\text{–}4}$.

Atypical teeth

With regard to variability in the number of teeth in the arch, only one case of a supernumerary was observed. No. 646, male, has a supernumerary dental element unerupted in the right palatal process 1 cm. distal of the anterior palatine foramen. The first molars have Carabelli cusps. There was one case of agenesia of the inferior lateral incisors.

There is an unmistakable tendency to diminution in size of the *superior* third molar, and the abnormally small teeth are lost earlier in life with a complete healing in of the alveolus, otherwise *Table 4* would show a greater number. In No. 509 these molars are mere abortive vestiges. *Table 4* shows this diminutive tendency of the superior third molar without a similar tendency to reduction of the inferior third. Indeed, there is evidence of much disharmony in size and form of these two members of the series. The superior molar was lost frequently without untoward result to the individual, and evidently was tending to disappear in this race; while the inferior molar retained its cusp form and size, with frequent impactions (*v. infra*, occlusion) and ensuing pathological processes.

TABLE 6

Accessory roots

MUS. NO.	SEX	TEETH	ANOMALY	MISCELLANEOUS
529	Male	Pm^2, Pm_1, M_1	Pm^2, M_1 bif.; Pm_1 trifur.	Rugged, simian jaws
639	Male	M^3, bilateral	Four roots	
644	Female	M^1, M^2	Additional lingual root	
646	Male	M_1, Pm_3, Pm_1	Distal root bifurcated, grooved, bifurcated	Broad teeth, ovoid arch
679	Male	I^1 right	Bifurcation line from cingulum to apex	

The teeth of this group, other than the exceptions noted, are average or smaller in size. The roots of large teeth tend to be bifurcated, and impactions result from incongruity in size of mandible and teeth. Conspicuous examples are listed in *Table 5*.

As observed by Wood-Jones (14) relative to the general features of these skulls, there is homogeneity of the dentitions. Variation in size and form is the exception. Observed anomalous conditions of the roots, such as deeply grooved, bifurcated, and additional roots, are given in *Table 6*. Mutilation of the specimens or radiography doubtless would reveal others. No. 529 has atypical jaws and dentition: large teeth; primitive cusp formula $\frac{4\text{–}4\text{–}4}{5\text{–}5\text{–}5}$; bifurcation of roots of the superior second premolar and the distal root of the inferior first molar; three roots to the inferior first premolar; roughened areas of insertion

of muscles of mastication; and squarish, rugged mandible and maxillae. These features may indicate reversion to an earlier phylogenetic type, or possibly mark this individual as an intruder; but his food and narcotic habits had been those of the group.

Occlusion

The Chamorros, though of Mongoloid stock, are characterized by facial prognathism (*v. infra*, gnathic index). But this facial protrusion is in part apparent only owing to a procumbency of the anterior part of the arches—sub-nasal prognathism—rather than to real facial prognathism, wherein the lower part of the face protrudes beyond a vertical line dropped from the forehead. The anterior teeth are inclined labially in ample, fan-like, symmetrical curves, which gives a Negroid fullness to the oral region. However, the incisors are not of spatulate form, nor the posterior teeth bell-shaped. There are no congenital diastema distal to the inferior cuspids. The incisors of adults have an edge-to-edge occlusion in the majority of cases, which may be considered the occlusal norm for the group. No. 509 is illustrative. The areas of origin and insertion of the muscles of mastication are generally but slightly roughened, indicating a rather weak masticatory musculature; the genial tubercles are ill defined. Their food was cooked and soft.

TABLE 7

Malocclusion

Superior		*Inferior*	
Third molar	2	Third molar	14
Second molar	1	Second molar	1
Second premolar	1	First premolar	2
First premolar	1	Cuspid	1
Incisors	8	Incisors	2
Total	13		20

Malocclusion, Class I (Angle), wherein one or more teeth are not in harmony with the line of occlusion, occurs in 15 per cent of these skulls. Impactions of inferior third molars are included. *Table 7* gives the number of times the respective teeth are involved.

Mental foramen

The location and bilateral symmetry of the mental foramina vary with the races of mankind. This foramen is located just below the vertical center of the body of the mandible, and antero-posteriorly anywhere from between the premolars to the apex of the mesial root of the first molar. Its usual position is in alignment with the second premolar. In this racial group there is asymmetry of location on the

TABLE 8

Mental foramen; 86 mandibles; per cent

LOCATION	RIGHT	LEFT	AVERAGE
Between Pm_1 and Pm_2	9	7	8
Below Pm_2	79	77	78
Between Pm_2 and M_1	8	12	10
Below mesial root M_1	4	4	4

TABLE 9

Résumé of maxillary measurements

	AVERAGE		MINIMUM		MAXIMUM		SKULLS	
	M	F	M	F	M	F	M	F
Prosthion-alveolon	53.5	50.5	46	42	60	57	(42)	(44)
Alveolar width	66.7	63.6	61	57	73	70		
Maxillo-alveolar index	125.4	126.1	110.9	114	144.6	138.3		
Basion-prosthion	100.3	96.4	92	87	112	107	(37)	(35)
Basion-nasion	102.1	96.9	95	90	111	110		
Gnathic index	98.3	99.5	91.5	90.6	107.3	106.4		
Dental length	43.1(8)		40		47			
Dental index	42.6		39.8		47			

two sides in 12.8 per cent; in 5 per cent there are accessory foramina of equal or smaller size than the normal opening.

Simonton (12) made a study of the location of the mental foramen in several widely differing groups of human crania as well as in anthropoid apes. He found a general tendency for the foramen to lie in line with Pm_2. Melanesians were exceptions to this rule, the most constant position for them was between Pm_2 and the mesial root of M_1. He found multiple foramina in 6 per cent of Caucasians, 11 per

cent of Melanesians, 16 per cent of Negroes, and 15 per cent of Chimpanzees.

Craniometry

The following standardized craniometric measurements were made in accordance with the definitions and technique outlined in Hrdlička's "Anthropometry:" (A) Skull—prosthion-alveolon and alveolar width from which the maxillo-alveolar index is calculated; basion-prosthion

TABLE 10

Range of mandibular measurements. Skulls: M (41), F (42)

	AVERAGE		MINIMUM		MAXIMUM	
	M	F	M	F	M	F
Symphysial height	31.8	30.4	30	22	36	39
Height of body: right	28.3	27.4	28	24	33	34
Height of body: left	28.8	27.2	27	23	33	33
Width of ramus, minimum: right	38.2	36.6	33	32	43	43
Width of ramus, minimum: left	38.7	36.3	34	31	45	42
Height of sigmoid notch: right	50.7	46.2	44	42	59	54
Height of sigmoid notch: left	50.0	45.7	43	40	58	54
Bigonial width	109.4	102.4	99	92	124	114

	BILATERAL SYMMETRY (PER CENT)	
	Males	Females
Height of body	31.7	48.5
Width of ramus: minimum	36.5	38.
Height of sigmoid notch	39.	35.7
Average	35.7	40.7

and basion-nasion from which the gnathic index is calculated; dental length, that is, the distance from the mesial surface of Pm^1 to the distal of M^3, teeth in situ; from this and the basion-nasion, the dental index is calculated. (B) Mandible—symphysial height, height of body, minimum width of ramus, height of sigmoid notch, and bigonial width (*Tables 9* and *10*).

Dental index

M^3 is missing from the dentition of many skulls through non-eruption, or ante- or post-mortem loss. Therefore, it was impractica-

ble to secure extensive data for determining the dental index. When present, M^3 is frequently diminutive, always small; and M^2 is rather small. It may be said that in this group, M^3 is distinctly degenerate to the verge of suppression; it is an abortive vestige of the normal size and morphology in many races. The dental length and index are thus reduced; the average index is 42.6, the group tending to be mesodent. There is, however, a considerable sexual difference, the dental length of males is greater than that of females. The soft diet of Micronesia may have tended to reduction of tooth size. As posited

TABLE 11

Classification of indices

	MALES		FEMALES	
	No.	Per cent	No.	Per cent
Maxillo-alveolar index:				
Dolichouranic	0	0	0	0
Mesuranic	2	4.8	2	4.5
Brachyuranic	40	95.2	42	95.5
	42	100	44	100
Gnathic index:				
Orthognathous	20	54	21	60
Mesognathous	14	37.9	10	28.6
Prognathous	3	8.1	4	11.4
	37	100	35	100

by Duckworth (3), reduction in size of teeth is attendant upon civilization, and directly upon diet and preparation of food.

Maxillo-alveolar index

The alveolar width, the maximum spread outside the second molars, is in every instance from 10–40 per cent greater than the palate length, from prosthion to alveolon. The palate is short, broad, and the dental arch roundish. This breadth of the alveolus, together with a broad spread of the zygomae and narrowness of the cranium in the temporal region, give these crania a resemblance to those of the Eskimo. Popular descriptions of the early Chamorros characterize them as being tall, muscular, light bronze in color, with high cheek bones and

heavy jaws. It is probable the present skeletal material is of their forbears. The mean maxillo-alveolar index for males is 125.4, maximum 144.6. Ninety-five per cent of the group have an index of 115 and over—brachyuranic (*Table 11*). This character is illustrative of the great homogeneity in the group: in an insular habitat there was doubtless considerable inbreeding.

Gnathic index

The gnathic index shows a considerable range of variation: 90.6 to 107.3, average 98.9. The average is well within the mesognathous class; but *Table 11* shows 54 per cent of males and 60 per cent of females to be orthognathous; and 8 and 11 per cent, respectively, prognathous. The greater the index, the greater the projection of the jaw, and consequently the more ape-like the countenance. Apparently there is a correlation between the gnathic index and size of M^3: in the orthognathous skulls, M^3 is usually either diminutive or missing; No. 509 is an exception. Many of the crania, particularly of females, present an apparent prognathism, which is largely sub-nasal between the akanthion and prosthion, affecting the anterior portion of the superior maxillae. The incisors are inclined labially, giving a Negroid fullness to the oral region. The data seem to point to a slight sexual factor in the gnathic index, which is displayed in *Table 12*. Relative to a sexual factor in the gnathic index, Duckworth (3) says no important differences have been observed in the skulls of Europeans, though there is indication of more pronounced maxillary projection in female crania. It is more pronounced in Australians, as given by Flower (4): females, 103.1 (33); males, 100.4 (73); difference, 2.7. Guam shows a difference of 1.2; there are also more prognathous females. The female thus tends to be more prognathous.

TABLE 12

Sexual factor in gnathic index

GNATHIC INDEX	AVERAGE	PROGNATHOUS	PER CENT
Females	99.5 (35)	Females	11.4
Males	98.3 (37)	Males	8.1
Difference	1.2	Difference	3.3

Mandible

Mandibular measurements are given in *Table 10*. In harmony with the wide rounded dental arches, the average bigonial width is fairly wide. There are well defined sexual differences in the mandibular dimensions, which are in consonance with many other cranial sexual characters. Marked asymmetry of the two sides is detailed in the table. The mandibles are fairly large, the mental and incisive regions are prominent; the incisors are well forward and occlude with the superior incisors in an edge-to-edge relation, prosharmosis; and the extent of interdigitation of the superior and inferior premolars and molars is much less than in the normal occlusion of Caucasians. M_3 is more often present than M^3, and is not so greatly reduced in size nor changed in form (*v. supra*, cusps), but consequently is frequently impacted.

III. PATHOLOGY

Ethnic deformation

Intentional mutilation of the dentition, while not a pathological process, may conveniently be considered in this section. Frequently untoward tissue changes ensue secondary to artificial destruction or deformation. Ethnic dental deformation assumes various forms with different primitive peoples: staining or blackening, filing in diverse ways, forceful extraction of one or more teeth as exemplified by the Hawaiian mourning custom (2).

The facial surfaces of the anterior twelve to fourteen teeth of the Chamorros are discolored, the shade varying from orange to blackish brown. Though there is evidence that this stain was sometimes applied purposefully, in the main it was incidental to the betel-chewing habit, which is considered separately. Nos. 463 and 458, females, as well as others, present evidence that the staining was purposeful, only surfaces exposed to view are stained. Safford (10) says: "Their teeth were stained black for the sake of ornament, and they bleached their hair with diverse washes" (p. 97). Females as young as sixteen years evidence the discoloration; nine female children and sub-adults had unstained teeth; but the teeth of all adult females are stained. There appear no differences between the sexes with regard to shade

of discoloration, about one-fourth of both have the orange hue. Staining of the teeth may have been an adolescent or betrothal rite. Japanese women formerly practised the latter by use of a black stain on the anterior teeth.

The Chamorros had another definite ethnic mode of dental mutilation practised by a few individuals: the labial surfaces of the superior anterior six teeth were marred by filing a diagonal cross-section design well into the enamel. Lips of potsherds, and other artifacts recovered from the same burials as this skeletal material, are decorated with this device, indicating a well established pattern. No. 481, female, age about 45, displays this deformation plainly. There are other fragmentary maxillae with teeth similarly mutilated. Owing particularly to post-mortem loss of the superior anterior six teeth, the smooth conical shape of the roots indicates why many of these teeth dropped from their alveoli; other cases are not available. The origin or significance of this lattice-design dental-deformation is not known.

Betel staining

The arresting feature of the teeth of the Chamorros is the discoloration from betel chewing. The facial surfaces of the anterior twelve to fourteen teeth, as well as the lingual surfaces of the superior incisors and cuspids, are permanently discolored. Other than children, only six adult males had unstained teeth; these persons were probably ascetics. The pigment is seldom distal to the mesial third of the first molars. Attritional facets in the enamel on the incisal edges, occlusal and approximating surfaces, are unstained; and seldom has the stain penetrated exposed dentinal tubuli as it does in the teeth of modern tobacco chewers. There is little stain in the grooves of the occlusal surfaces; nor is there any appreciable discoloration of the lingual surfaces save on the superior six or eight teeth. No. 711 is a typical example.

Factors limiting the discoloration evidently were trituration of food, frictional influence of tongue, and dilution of saliva. Near the orifices of the salivary ducts the enamel presents unstained surfaces. The discoloration was limited cervically by the height of the investing soft tissues. The distribution of the stain and the clean facets exclude the possibility of the stain being a post-mortem organic contamination.

The testimony of early voyageurs, as well as contemporary observers in southern Asia and the southeast Pacific, confirm betel chewing as the cause. This widely distributed habit of the Orient, deeply entrenched socially, was interwoven with niceties of social intercourse. Both socially and physiologically betel-nut chewing is strongly habit forming. Some of the desired effects on the habitué were stimulation by the active principle of the Areca nut, *aracaine*, a poisonous alkaloid not unlike *nicotine* and possessing powerful properties for destroying tapeworms; as a digestive, comparable to the after-dinner effect of tobacco; and, particularly with women, the wanted vermillion of lips and tongue. This custom of lavishly tinting the lips with the pigment of the betel-nut concoction is probably a cultural trait convergent to the world-spread custom of application of rouge to the lips by females. The quid was not so much triturated as it was held in the facial vestibule; continued action was sought, and with older individuals the material was retained until quite completely dissolved. The habitual location of the quid, and purposeful coloration of the lips, largely account for the distribution on the facial surfaces of the teeth.

Intact, sound enamel *per se* is unstainable (8). Section of the facial enamel of Chamorro teeth shows the stain to have penetrated but a fractional part of the thickness. This superficial impregnation of the enamel could not have occurred without superficial partial decalcification of this dense inorganic tissue, thus producing shallow interstices between the enamel rods into which the coloring and other organic material was precipitated. Dr. Panchanan Mitra, an Indian anthropologist, informs me that in India, besides the usually listed components of the preparation (slice of areca nut, lime, and pepper leaf), there is added the juice of a certain tree, which is acid in reaction and contains a very soluble reddish pigment. Some similar plant juice, markedly acid in reaction, must have been used in Guam, which etched the enamel and made possible the permanent inclusion of the organic pigment. While vermilion lips have been universally the vogue, discolored teeth in modern times have become increasingly less desirable in Micronesia and elsewhere in the Orient, and efforts are made to cleanse the discolored enamel by means of rubbing with fibrous twigs often sprinkled with fine beach sand. Other than the disfigurement and a slight etching of the facial enamel, this tissue did

not succumb to the betel-nut habit. The effects of betel-nut chewing on the investing tissues of the teeth are next considered.

Lime accretions

The excretion of calcium and other salts in the saliva is a physiological process that varies with metabolism. On contact with air the dissolved salts tend to precipitate on the surfaces of teeth in the proximity of the orifices of the salivary ducts; viz., upon the lingual surfaces of the inferior incisors, and the facial surface of the superior first molar. Friction of tongue and food, particularly if fibrous and requiring vigorous mastication, reduces the adhesion of these precipitates. Artificial cleansing with fibrous plants or brush is more positive. People addicted to the betel-nut concoction, an ingredient of which is pulverized lime, are subject to additional deposits from this source. The teeth of individuals in this collection under thirty-five years of age are quite free from extraneous deposits; but with advancing years the lime accretions become increasingly larger, particularly on the facial surfaces of the molars. The lingual surfaces of the inferior incisors are free from deposits in practically all cases, in contrast to the condition prevailing on these teeth in the mouths of modern people. It would appear that the locus of the deposits is determined in part by the habitual position of the betel-nut quid in the buccal vestibule. On some dentitions, such as Nos. 666 and 671, the accretions are enormous. The deposits overlay discolored enamel, the discoloration in most instances having occurred at about puberty. If the natural physiological processes served to prevent deposits in those younger than middle age, without the use of artificial means, it is evident that those beyond thirty-five were not as vigorous in their masticatory habits, nor did they have recourse to artificial methods of cleaning. But as their diet was soft and cooked, it required little masticatory function; and the lime-containing betel-nut concoction directly produced excessive lime-accretions on the facial surfaces of the molar teeth. The lime accretions accompany, and are parallel to, degenerative changes in the osseous support of the teeth; and it seems a justifiable inference that these accretions, together with other active irritants, have directly produced marginal inflammation of the investing tissues. No. 664 is typical of these conditions.

Periodontoclasia (alveoloclasia)

Periodontoclasia is a chronic destructive degeneration of the investing tissues of teeth eventuating in exfoliation. Alveoloclasia is the breaking down of the alveolar wall. Direct observation of the latter only can be made on skeletal material. There is a gradual recession of the alveolar crest from childhood to late adult life even with well preserved dentitions that may be considered free from alveoloclasia. The distance from the enamel margin to the alveolar crest gradually increases. This increase is, in effect, a continued physiological eruption of the teeth. The distance from the enamel border to the crest of the alveolus, at the mesio-facial angle of the superior and inferior first molars in such skulls, was measured. Appreciable deviations in the height of the alveolar process from the norms given in *Table 13*, together with resorption of septal and intra-alveolar bone, are pathologic. The alveolar process investing the inferior molar is heavier, and, in a majority of cases, approaches the enamel border closer than the process supporting the superior molar. The texture and thickness of the alveolar process of males, in this group, is more rugged than that of females; and there are no females beyond middle life with well preserved alveolar processes.

Periodontoclasia—premature loss of teeth through degeneration of the supporting tissues—is the pathologic process of highest incidence among these people. The onset of the lesion was rare under thirty-five; all females over forty had one or more teeth involved; while 66 per cent of the males beyond thirty-five had well marked lesions at decease. Determinants of this sexual difference are: heavier, stronger osseous structure of males; more vigorous functioning of the dentition of males; females, possibly for cosmetic purposes, were more uniformly addicted to the betel-nut habit than males. The ancient male Chamorros were reputed to be tall, muscular, and with high cheek bones and heavy jaws. *Table 14* shows the incidence of the lesion to be highest with the third molar, progressively less with the second and first molars, and much less with the ante-molar teeth, save the inferior incisors of males. A higher percentage of all anterior teeth of males than of females was involved. Various stages of resorption of the alveolar support are present in the group; and as the resorption approaches the apex, exfoliation is the inevitable result. *Table 15* gives

TABLE 13

Normal height of alveolar crest

MUS. NO.	MALES			MUS. NO.	FEMALES		
	Age	M^1	M_1		Age	M^1	M_1
		mm.	mm.			mm.	mm.
770	18	1	1	610	9	0	0
658	25	2	2	626	14	1	1
685	30	2	1	640	18	1	1
441	35	2	2	615	20	1	1
716	40	2	1	631	20	2	1
529	40	3	2	643	25	2	1
620	40	1	2	467	30	3	1
716	45	3	1	728	35	2	1
740	45	4	3	509	35	3	1.5
468	50	3	2	732	35	2	2
453	50	2	3	663	40	4	2

TABLE 14

Teeth involved in alveoloclasia (per cent)

MALES: 31 SKULLS				FEMALES: 21 SKULLS			
M^3	69	M_3	65	M^3	69	M_3	55
M^2	46	M_2	48	M^2	66	M_2	35
M^1	42	M_1	45	M^1	52	M_1	33
Pm^2	38	Pm_2	21	Pm^2	29	Pm_2	16
Pm^1	35	Pm_1	24	Pm^1	19	Pm_1	14
C	26	C	29	C	7	C	9
I^2	22	I_2	40	I^2	14	I_2	19
I^1	22	I_1	43	I^1	17	I_1	21

TABLE 15

Teeth lost ante-mortem

53 skulls: absolute per cent

M^3	66	M_3	51
M^2	13	M_2	13
M^1	11	M_1	10
Pm^2	9	Pm_2	5
Pm^1	12	Pm_1	11
C	6	C	12
I^2	19	I_2	28
I^1	18	I_1	30

teeth lost ante-mortem. As periodontoclasia was the major cause, there is a strong correlation between that table and *Table 14*.

Etiologically, the following conditions may be considered: (a) irritation of the investing tissues by betel-nut chewing—both the immediate and repeated effect of the concoction on the soft tissues, and constant chronic inflammation produced by fixed lime-accretions; (b) the soft monotonous diet requiring little resistant mastication, and probably deficient in such essentials as anti-scorbutic vitamin; (c) generally, a high susceptibility to periodontal infection and degeneration determined by hereditary, dietary, sedentary, and climatic factors. High susceptibility to periodontal disease, by a people living in a habitat similar to that of the Chamorros is exemplified in the Filipinos, who are subject to virulent destructive parietal abscesses, with resultant loss of teeth. Periodontal degeneration is a concomitant of betel-nut chewing throughout the Orient, as vouched by many competent observers; and this skeletal material indicates its positive local rôle in causation.

No person under thirty had lost any teeth at decease, which is a remarkably favorable dental condition in contrast with that of modern Caucasians. Sixty-four per cent of those older than thirty had lost one or more teeth, but the table indicates that in many instances the third molars only were missing. There were four edentulous males and one female. Periodontoclasia caused the loss of nearly all; caries, attrition, "gangosa," traumatism, a few each.

Caries

Dental caries is a molecular decalcification and disintegration of the hard parts of the teeth. It is initiated on the surface and extends pulpward, and is bacterial in character. In this group of one hundred six skulls, nineteen, or 18 per cent, have one or more carious teeth. Of the nineteen individuals, three were young adults, five of middle age, and eleven old persons. The latter had typical senile carious lesions—initiated at the cervix beyond the protective enamel. There are forty-two carious teeth, of which 60 per cent are of the senile type. Forty per cent of cavities are localized in pits on occlusal and facial surfaces of molars and premolars. Five of the nineteen cases have

six periapical osseous lesions resultant from pulp exposure through the caries process.

In these crania there are not a few molars and premolars having deep occlusal grooves at the bottom of which are fissures, faults in the coalescence of the separate lobes, or irregular pits, yet which are entirely free from caries. Thus a defective or hypoplastic tooth is not necessarily symptomatic of caries, but the specific environmental cause of caries must exist before either a sound or hypoplastic tooth will succumb to this decalcifying process. The freedom of children

TABLE 16

Localization of caries

MAXILLARY	PER CENT OF CAVITIES	MANDIBULAR	PER CENT OF CAVITIES
Third molar	9.5	Third molar	2.4
Second molar	26.2	Second molar	21.4
First molar	4.8	First molar	9.5
Second premolar	2.4	Second premolar	4.8
First premolar	2.4	First premolar	4.8
Cuspid	7.0	Cuspid	0
Second incisor	4.8	Second incisor	0
First incisor	0	First incisor	0
	57.1		42.9

	CAVITIES	PER CENT
Surface on which initiated:		
Pits in occlusal and facial, of molars and premolars	17	40.5
Cervix-facial, mesial, distal (senile type)	25	59.5
	42	100

and youth in this race from caries is in sharp contrast to the incidence in modern people. The comparative immunity until middle life is analogous to the occurrence of caries in the old Hawaiians (2).

Attrition

Attrition is the gradual wearing away of the hard parts of the teeth through the physical and physiological agencies of mastication of food and narcotics. Attrition is common to most primitive peoples; it was of extensive pathological significance in aboriginal California (7). The

degree of wear may range from slight enamel facets to pulp exposure, with its pernicious sequelae. The plane of wear on the inferior teeth slants obtusely from the linguo-occlusal angle toward the bucco-cervical margin of the enamel; that on the superior teeth is the reverse. Extensive attrition exposing the dental pulp is a concomitant of senility with some races. The betel-nut concoction, especially because of its lime content, has an abrasive effect on the teeth, but not nearly so great as might be imagined, for the habit was to hold the bolus in the buccal vestibule rather than actively to chew it. The food in Micronesia was cooked and soft, and apparently no abrasives were introduced in the preparation. Individuals in this group under twenty-five showed very slight wear; those under forty but little; while seven old individuals had teeth worn to exposure of the pulp—fourth degree attrition—with nineteen resultant periapical osseous lesions.

TABLE 17

Periapical osteitis

SKULLS	PRIMARY CAUSE	LESIONS	PER CENT
7	Attrition	19	59.4
4	Fracture	7	21.8
6	Caries	6	18.8

Traumatism

Fracture of teeth constitutes an appreciable amount of dental pathology, especially with primitive races. Combat and use of the dentition as tools are responsible for this painful injury. Fracture causing immediate exposure of the pulp, or continued irritation though not frankly exposed, results in its necrosis and in microbic invasion of the periapical tissues, with permanent chronic osteitis or abscess. Seven per cent of this group had fractured teeth; of twelve fractured teeth, seven had caused pulp necrosis and periapical osteitis. There was one case of a healed fractured mandible.

Periapical osteitis

Pulp exposure from any cause is followed in course by its infection and necrosis, with subsequent chronic infection via the apical foramina

of the periapical tissues, the latter ordinarily producing a proliferating periodontitis and limited osteitis. There may or may not be a fistula leading to the oral cavity. Sixteen per cent of these skulls evidence chronic periapical osteitis. *Table 17* gives the primary causes. With modern people caries is the usual cause of periapical lesions.

Paradental lesions

Lesions of considerable size in continuity with the teeth not included in the above categories are now considered. Impacted mandibular third molars were provocative of marked osseous disturbance. Through resorption of surrounding bone the organism attempted to erupt, resorb, or cast off these non-erupted teeth, the reaction having been somewhat similar to that stimulated by a foreign body. In eleven impactions, lesions from 1–3 cm. in diameter occur; Nos. 683 and 477 are examples. In several not only is there extensive resorption of bone, but also resorption of the opposing distal wall of the second molar to the point of pulp exposure, with its necrosis and resultant periapical lesion. Thus reduction in jaw size is accompanied by aberrant eruption and severe pathological processes.

No. 663 has a lesion about 1 cm. in diameter buccally of Pm^{1}, probably due to a foreign body or retained deciduous root. No dental cysts were observed in the series. Neither are there any cases of chronic sinusitis of dental origin, as may occur with fistula leading from a periapical lesion into the maxillary sinus.

Several skulls have extensive eroded lesions in the palate and nose, with sunken saddle-shaped nasal bones. Some have old lesions in the outer table of the calvarium. These lesions are not unlike those of tertiary syphilis. No. 617 has extensive lesions of the palate, vomer, and turbinates, and sunken nasal bones. No. 632 has an aperture 1 cm. in diameter in the floor of the left naris, with a smooth, well-rounded margin continuous with the lingual plate of the alveolar process, the left incisors having been lost through the necrosis, and the vomer and turbinates largely destroyed. The etiology of these lesions was probably yaws, a disease like syphilis, and known as "gangosa." The Spanish or Oriental origin of this disease would help to establish the antiquity of this skeletal material.

IV. SUMMARY

The ancient inhabitants of Guam subsisted exclusively upon the flora and fauna of their insular habitat. Their food consisted of fish, some fowl, bread-fruit, taro, yams, rice, bananas, coconuts. Screw pine and sea-weeds served as relishes. Bread-fruit and fish were dried and stored. As throughout the tropical Pacific, they cooked the food in pits in the earth with heated stones. They did not eat to excess nor did they use fermented beverages.

Betel nut was the narcotic to which they were strongly addicted. This is a cultural trait of wide Oriental distribution. The nut used is from the betel palm, *Areca catechu*. A part of the nut is wrapped with a few leaves of betel pepper, *Piper betle*, and the whole sprinkled with a pinch of lime, the latter secured by burning coral. This has a marked stimulant effect. The betel juice also produces a soluble red pigment, which colors the saliva, lips, and mouth a rich red, and gradually but permanently discolors the teeth.

Morphological features of note: The cervical margin of the enamel streams into the bifurcations, particularly of the inferior second and third molars, terminating in an acute point. Occasionally beyond this point, a detached enamel pearl is found. This feature is absent in Caucasians, and more prominent in many American Indian tribes than in this group.

A peculiar feature of these teeth is a corrugation of the enamel on the buccal aspect of the superior premolars and molars. It consists of a horizontal, rounded, unfaulted, groove with a low ridge above and below it. The cervical ridge may be interpreted by some as a cingulum.

Marginal ridges on the lingual aspect of the superior incisors are not prominent in this series, being present in moderate degree only on some 20 per cent.

The cusp formula of this group tends to be $\frac{4\text{–}4\text{–}4}{5\text{–}4\text{–}4}$. The mandibular first molar is constant; the second molar is quadricuspid in 80 per cent; the maxillary third molar is the most variable. Such a cusp formula is not indicative of a primitive race. There is a decided tendency to diminution in the size of the maxillary third molar. In many skulls it is a mere abortive vestige; frequently it is not erupted. There

FIG. 1. No. 631. Female, young adult about 25. Typical cranium and jaws; subnasal prognathism; occlusion is of the prosharmosis form: little or no overlapping of the superior teeth, slight interdigitation of posterior teeth. M^3 is small and erupting malposed. Facial surfaces of ante-molar teeth have been stained with betel nut, the white cervical border having been covered by the gingivae in the living.

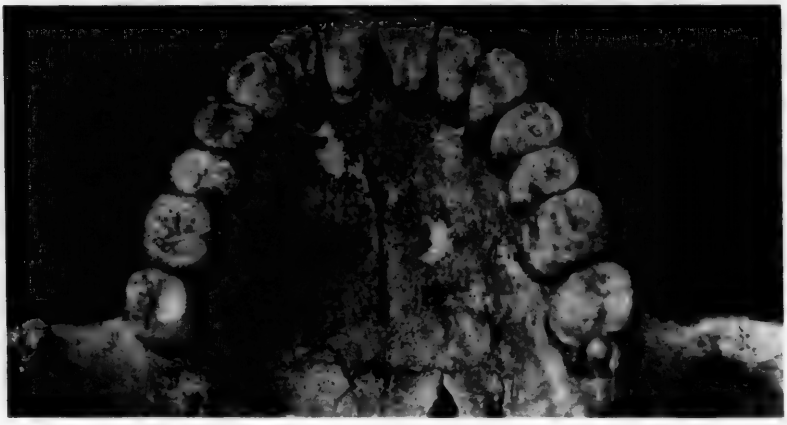

FIG. 2. No. 509. Female, 35. Palate is roundish, narrow teeth. M^3 is an abortive vestige; ^3M, lost ante-mortem, also extremely abortive. Betel chewer, but little stain on lingual and occlusal surfaces.

FIG. 3. No. 646. Male, 40. Parabolic arch; broad anterior teeth, molars noticeably decrease in size successively backward. Supernumerary dental element non-erupted in palate. ^{2}Pm, fractured buccal cusp; periapical osteitis, with resultant fistula opening in palate.

FIG. 4. No. 481. Female, about 45. Ethnic mutilation of the anterior maxillary eight teeth: a lattice design is filed into the enamel. Betel staining. ^{1}Pm has fourth degree attrition on occlusal aspect, not shown in this view, with resultant periapical osteitis.

are some males with large angular jaws, and large teeth with accessory roots.

The normal occlusion is characterized by a slight procumbency of the incisors, with attendant edge-to-edge occlusion, and slight interdigitation of the posterior teeth—prosharmosis. The masticatory musculature was weak. Malocclusion occurred in 15 per cent. Impaction of mandibular third molars was frequent.

The mental foramen was below Pm_2 in about 80 per cent.

The palate is short, broad, and roundish; 95 per cent are brachyuranic. The average dental index is 42.6. The group tends to be mesodont. The average gnathic index is 98.9—mesognathous. Many of the crania, particularly females, present an apparent prognathism. This is sub-nasal, between the akanthion and prosthion, giving a Negroid fullness to the oral region. There are marked sexual differences in the group; otherwise homogeneity characterizes it. The somatological characters herein described point unmistakably to Mongoloid affiliations.

The teeth are well formed; but 5 per cent evidence slight developmental disturbance. Ethnic deformation was practised to a limited extent by filing a lattice design on the facial surfaces of the six superior anterior teeth. Staining the teeth an orange to black color was customary.

Betel-nut chewing was universal. Its deleterious effects on the teeth were permanent discoloration of the enamel on the facial surfaces particularly, and predisposition of investing dental tissues to degeneration. The betel-nut concoction, because of its lime content, produced enormous accretions on the teeth, which, through impingement on the gingivae and alveolar process, caused chronic irritation and inflammation. The repeated and long continued action of the narcotic bolus furthered the chronic inflammatory process.

The betel-nut habit, together with a soft diet requiring but little mastication, were the primary factors in producing a high incidence of periodontoclasia—chronic destructive degeneration of the investing tissues of the teeth—which eventuates in exfoliation. Practically all females and 65 per cent of males beyond forty had teeth involved by periodontal disease. The third molars were affected most fre-

quently. No person under thirty had lost any teeth at decease. Periodontoclasia was the major cause of loss in later life.

Dental caries occurs in 18 per cent of the skulls. Sixteen per cent evidence periapical lesions, secondary to caries, attrition, and fracture. Impacted third molars caused extensive disturbance of the tissues. Serious lesions of the palate and nose of some skulls were evidently resultant from yaws.

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Tripler Hospital,
Honolulu, Hawaii.

STUDIES OF THE VALIDITY OF ADVERTISED CLAIMS FOR DENTAL INDUSTRIAL PRODUCTS[1]

III. Bleachodent, Ekay, Ex-Tartar, Snovy-White, and Tartaroff[2]

RESEARCH COUNCIL OF THE NEW YORK ACADEMY OF DENTISTRY[3]
WITH THE COLLABORATION OF
CHARLES F. BÖDECKER, D.D.S., F.A.C.D., EDMUND APPLEBAUM, D.D.S., AND MAXWELL KARSHAN, M.A., PH.D.
Columbia University, New York City

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I

Abstract of the Council's Findings Relating to Bleachodent, Ekay, Ex-Tartar, Snovy-White, and Tartaroff[2]

FOR THE COUNCIL: WILLIAM J. GIES, CHAIRMAN

1. The destructive nature of various advertised "tooth-cleaning" fluids has been brought to the Council's attention.

2. *Bleachodent* (Bleachodent Dental Laboratories, Inc., New York and Toronto), *Ekay* (Filmoff Company of America, Inc., New York City), *Ex-Tartar* (Detroit Pharmacal Company, Inc., New York City),

[1] Previous reports by the Council: (1) Taxi and Stain Remover; effect of so-called tooth-cleaning fluids on dental enamel, *Journal of Dental Research*, 1927, vii, p. 477. (II) Lymeogene, a French tooth-powder, *Ibid.*, 1929, ix, p. 171. The findings in this public report were announced at a meeting of the New York Academy of Dentistry, Yale Club, New York City, April 24, 1930.

[2] The name of the fourth product, "Snovy-White," is spelled here as it is on the label on the containers. "Ekay special tooth white" was "formerly marketed as 'Ritz'."

[3] The Research Council of the New York Academy of Dentistry was established in February, 1927: *Journal of Dental Research*, 1927, vii, p. 509.

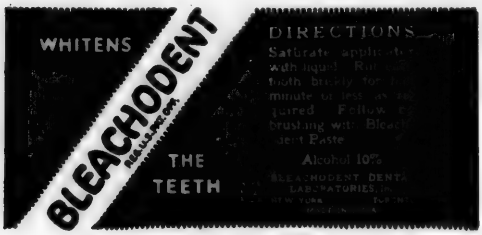

FIG. 1. TYPOGRAPHIC REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING BLEACHODENT

Color: purple. Reads: Bleachodent (Reg. U. S. Pat. Off.) whitens the teeth. Directions: Saturate applicator with liquid. Rub each tooth briskly for half minute or less, as required. Follow by brushing with Bleachodent Paste. Alcohol 10 per cent. Bleachodent Dental Laboratories, Inc., New York, Toronto. Made in U. S. A.

EKAY
SPECIAL
TOOTH
WHITE
DIRECTIONS
APPLY TO TEETH WITH A COTTON SWAB OR CLOTH RUBBING GENTLY WILL REMOVE TARTAR, FILM, TOBACCO STAINS, ETC.
NET CONTENTS 1-4 OZ.
MADE BY FILMOFF COMPANY OF AMERICA, INC. NEW YORK CITY

FIG. 2. TYPOGRAPHIC REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING EKAY

Color: yellow

FIG. 3. TYPOGRAPHIC REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING EX-TARTAR

Black. Reads: Ex-Tartar (Trade Mark Reg. U. S. Pat. Off.) renders discolored and unsightly teeth snow-white by instantly removing film. Absolutely harmless to gums or fillings. *Directions:*—Pour a small quantity of Ex-Tartar on your tooth brush, then rub over teeth. Follow this by an application of tooth paste. Manufactured by Detroit Pharmacal Co., Inc., Mfg. Pharmaceutical Chemists, New York, N. Y., U. S. A.

Snovy-White (New York Research Laboratory, New York City), and *Tartaroff* (Tartaroff Company, Chicago, Ill.), which the manufacturers publicly claim *whiten teeth*, have been submitted to careful examination. Typographic reproductions of the varicolored labels on bottles containing these products are shown in *figs. 1–5*, inclusive.

3. Samples of *Bleachodent*, *Ekay*, and *Tartaroff*, bought in the open

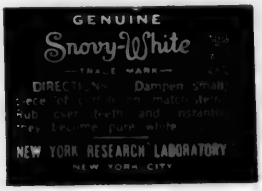

FIG. 4. TYPOGRAPHIC REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING SNOVY-WHITE

Color: dark blue. Reads: Genuine Snovy-White (Trade Mark). *Directions:*— Dampen small piece of cotton on match-stem. Rub over teeth and instantly they become pure white. New York Research Laboratory, New York City.

FIG. 5. TYPOGRAPHIC REPRODUCTION OF THE LABEL ON A BOTTLE CONTAINING TARTAROFF

Color: light blue

market, were found to contain large proportions of "strong" mineral acid.

4. Samples of *Bleachodent*, *Ekay*, *Ex-Tartar*, *Snovy-White*, and *Tartaroff*, bought in the open market, when applied to teeth for from one to five minutes, caused severe destruction of enamel.

5. None of the five products named above (4) can be applied to teeth, as directed on the labels on the containers, without causing permanent injury of the enamel.

6. None of the claims set forth on the labels on the containers in which these fluids (4) have been sold was accompanied by a statement of warning that the promised whitening effects on teeth are due to destruction and removal of enamel, with consequent exposure of new and roughened surfaces of enamel. The reliant purchaser is given no reason to believe that any of these fluids (4) has undesirable effects.

7. Comparatively simple tests of the products, by their manufacturers or sponsors, would have shown the injurious character of these fluids and the serious danger to the public welfare from their use.

Opinions of the individual members of the Council

Concurrent (4): Henry W. Gillett
Arthur H. Merritt
Bissell B. Palmer, Secretary
Leuman M. Waugh

Concurrent, with reservations: None

Non-concurrent: None

Unrecorded (2): Charles F. Bödecker, who conducted some of the tests described below.
Member to be appointed (to fill a vacancy)

Acknowledgment

The accompanying reports, by Drs. Charles F. Bödecker, Edmund Applebaum, and Maxwell Karshan, present some of the scientific data on which the Council's foregoing findings are based. The expenses of this study have been met in part from current appropriations for the support of research in the Dental and Medical Schools of Columbia University. The Council records its appreciation of this important public service at both schools, and also of the disinterested coöperation of Drs. Bödecker, Applebaum, and Karshan.

II

So-called Tooth-Cleaning Fluids Sold to the Public

A. HISTOLOGICAL FINDINGS

CHARLES F. BÖDECKER, D.D.S., F.A.C.D., AND EDMUND APPLEBAUM, D.D.S.

Laboratory of Oral Histology and Embryology, School of Dental and Oral Surgery, Columbia University, New York City

Introduction

A number of agents used to whiten teeth are sold directly to the public at drug stores and department stores. A previous report[4] indicated some harmful effects of two tooth-cleaning fluids that were sold only to dentists. The present report pertains to fluids having a similar action, but which have been available to the public. They are sold, as one manufacturer claims, for the purpose of making the teeth as "white as snow in the magic of a moment." They undoubtedly do this, but direct tests show that they also attack the enamel and that, therefore, their use is injurious. Teeth treated with them become a chalky white, but soon turn dark and are then more liable to decay. The five "cleaning" fluids named below are harmful even when applied by skilled dentists, but their destructiveness when used by the lay public is greater and may be very serious.

Method

About twenty extracted, upper, central incisors, with normal labial surfaces, were selected for tests of the "cleaning action" of five fluids bought in the open market, and sold under the trade names, *Bleachodent*, *Ekay*, *Ex-Tartar*, *Snovy-White*, and *Tartaroff*. Each tooth to be tested was carefully dried, and the middle third of the labial surface covered with sticky wax to serve as a control. Then it was rubbed, for one, three, or five minutes, with a pledget of cotton on an applicator soaked in one of the cleaning fluids, and at the end of this treatment

[4] Studies of the validity of advertised claims for dental industrial products. I. "Taxi" and "Stain Remover;" *Journal of Dental Research*, 1927, vii, p. 477; Bödecker, p. 480; Karshan, p. 496.

immediately dipped into a solution of sodium bicarbonate to neutralize any acid in the adherent cleaning fluid. Next, the sticky wax was removed and the teeth, after having been washed in running water, were placed in 1 percent solution of silver nitrate for four minutes, and finally in 10 percent formalin to precipitate the silver. It was then noted that the part of each tooth that had been in contact with the

FIG. 6. THE EFFECT OF BLEACHODENT APPLIED FOR FROM ONE TO FIVE MINUTES

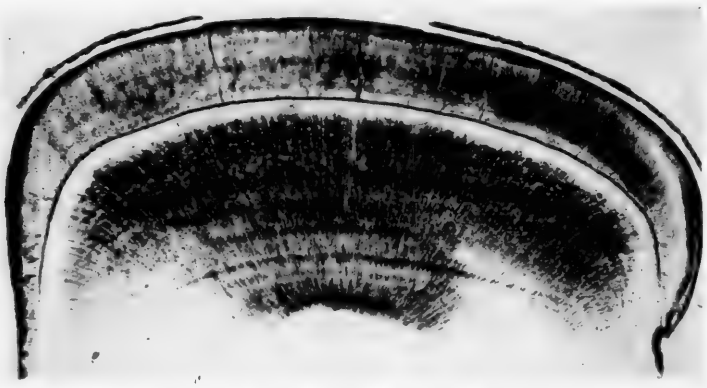

FIG. 7. A SECTION OF AN INCISOR TREATED WITH BLEACHODENT

The portions of the enamel marked by external lines were not protected by wax, and show the effect of the fluid. × 7.

cleaning fluid was uniformly stained a more or less intense black, according to the length of the "treatment" (one, three, or five minutes). In each case, however, the middle zone on the labial surface, which had been protected by wax against the action of cleaning fluid, remained white and practically unstained (*figs. 6, 9, 12,* and *15*).

Then sections of representatives of each group of teeth were pre-

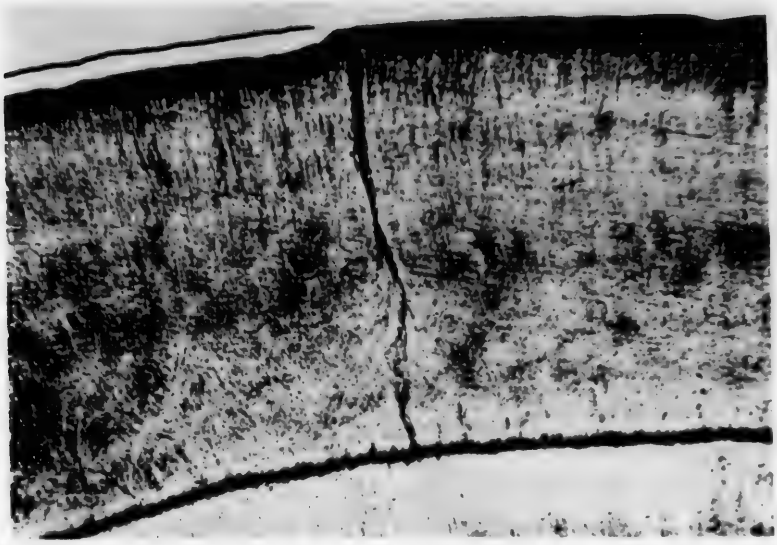

FIG. 8. SAME AS *Fig. 7*; ENLARGEMENT, × 60

An appreciable "step" separates the enamel affected by the Bleachodent from the control area.

FIG. 9. THE EFFECT OF EKAY APPLIED FOR FROM ONE TO FIVE MINUTES

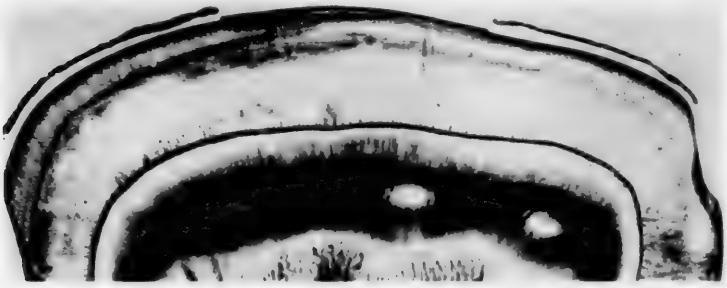

FIG. 10. A SECTION OF AN INCISOR TREATED WITH EKAY

The affected areas marked by external lines are clearly differentiated from the protected enamel. × 7.

pared and examined under the microscope, in low and medium enlargements. This examination disclosed a distinct difference, in each case,

FIG. 11. SAME AS *Fig. 10*; ENLARGEMENT, × 60

Approximately 3 per cent of the enamel has been destroyed by one application of the fluid.

FIG. 12. THE EFFECT OF EX-TARTAR APPLIED FOR FROM ONE TO FIVE MINUTES

between the area of enamel protected by wax and that exposed to the action of tooth-cleaning fluid. The extent of the damage depended

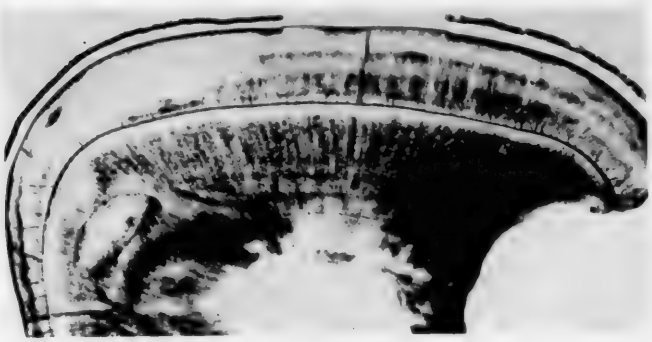

FIG. 13. A SECTION OF AN INCISOR TREATED WITH EX-TARTAR

The affected areas marked by external lines are clearly seen to have been attacked by the cleaning fluid.

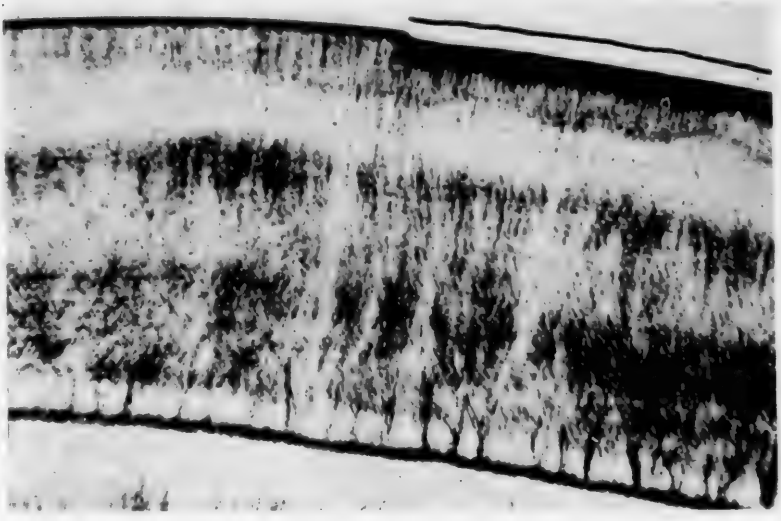

FIG. 14. SAME AS *Fig. 13*; ENLARGEMENT, × 60

The permeability of the enamel appears to have been perceptibly increased, as shown by the penetration of the silver nitrate.

upon the period of exposure, which in no case was more than five minutes. In all these sections, there was an appreciable difference between the affected and unaffected areas of enamel, many showing marked losses of enamel where the cleaning fluid had been in contact.

FIG. 15. THE EFFECT OF SNOVY-WHITE APPLIED FOR FROM ONE TO FIVE MINUTES

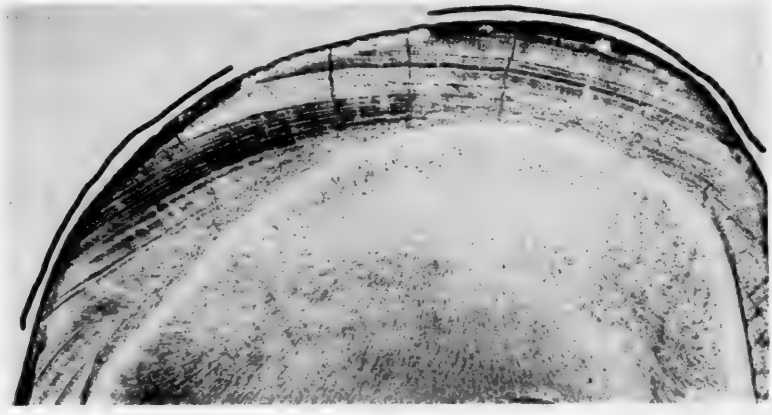

FIG. 16. A SECTION OF AN INCISOR TREATED WITH SNOVY-WHITE

The extent of the dissolution of the enamel is not fully disclosed because the section was cut somewhat obliquely. × 7.

The depth of the removal indicates the amount of enamel actually destroyed by a single application of cleaning fluid. Furthermore, silver nitrate penetrated more deeply into the enamel on the affected areas, which apparently were rendered more permeable (*figs. 7, 8, 10, 11, 13, 14, 16, 17, 18*).

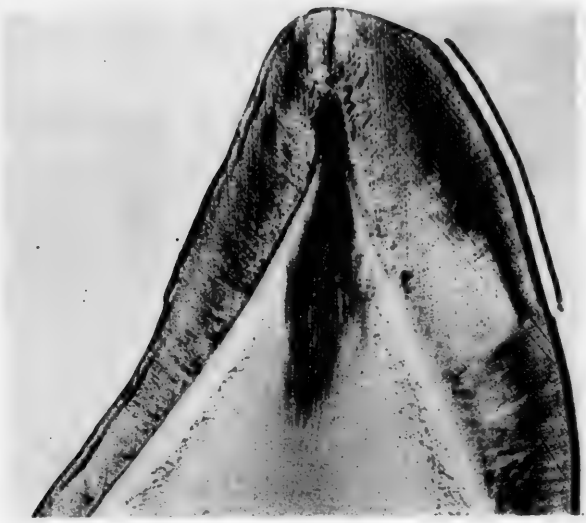

FIG. 17. A LONGITUDINAL SECTION OF A CUSPID TREATED FOR FROM ONE TO FIVE MINUTES WITH TARTAROFF. × 7

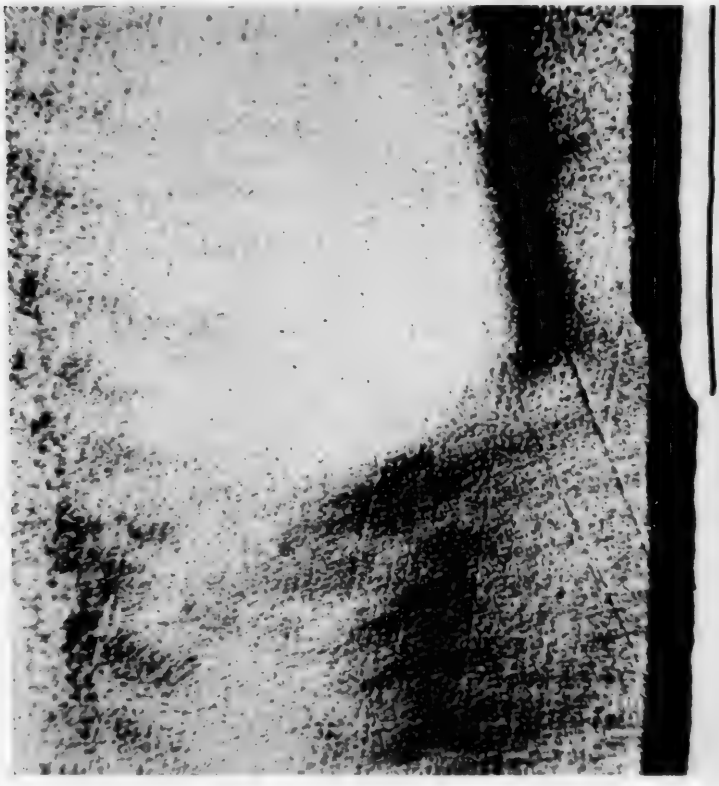

FIG. 18. SAME AS *Fig. 17*; ENLARGEMENT, × 60
An appreciable destruction of enamel is evident

Microscopic changes in enamel caused by acid tooth-cleaning fluids

Dental enamel is composed of a countless number of exceedingly minute rods (4μ or 4/25,000 of an inch in width) held together by a slight amount of cementing substance. As it has a very high percentage of calcium phosphate, some acids readily disintegrate this tissue. The first action of an acid in attacking enamel is to remove mineral salts from the cementing substance between the rods, thus altering its lustre—individual enamel rods are not then held so firmly together, the affected parts being more friable and more permeable. When any of the above named cleaning fluids is allowed to act upon enamel for only a very brief period, a roughening causes the tooth to appear chalky white, and thus the promise of the advertisements of the manufacturer is apparently fulfilled. This roughened surface, however, soon accumulates various pigments—from food and tobacco, for example—and the tooth becomes more unsightly than ever. Such dire results may be sufficient to cause many of the innocent public to desist from further effort to whiten teeth by this means. Not only do teeth become darker, after only a single use of such "tooth-cleaning" fluids, but their liability to decay is greatly augmented by the roughening of the surfaces and the increased permeability of the enamel.

Roughening of enamel caused by acid tooth-cleaning fluids

Normal enamel has a highly glazed surface with only the slightest undulations marking the imbrication lines. Such a surface affords little opportunity for the attachment of food debris or of mucin plaques. When the latter form on the normally glazed surface of enamel, they can be removed with a tooth-brush. After enamel has been treated with an acid tooth-cleaning fluid, however, both food debris and mucin plaques adhere tenaciously and cannot easily be removed with a tooth-brush. The removal of food debris and mucin plaques is possible, of course, only on accessible areas of teeth. Inaccessible areas, such as interproximal surfaces, retain food on roughened surfaces and therefore become more liable to decay.

Some manufacturers of acid tooth-cleaning fluids have claimed that such agents are not more harmful to the teeth than various *foods* that contain acid. The most striking example of such a food is lemon.

Comparative tests have been made to determine the possible harmfulness of pure lemon juice by applying a portion to teeth in the manner described above. It was found that lemon juice had no ill effects. Therefore, the ingestion of lemonades cannot be harmful. The claims of manufacturers that their products are not more harmful than lemons are absurd. In an effort to determine the action of pure lemon juice on enamel for a *long period*, a tooth was kept in a portion for twenty-four hours. This resulted in some decalcification of the enamel, showing that under extraordinary conditions a tooth would be harmed by the acid in even a common *food*.

Increased permeability of dental enamel caused by acid tooth-cleaning fluids

An increase in permeability of the enamel is detrimental to the welfare of a tooth. That the above-mentioned cleaning fluids have this effect is shown by the augmented penetration of silver nitrate into areas affected by them. When mucin plaques form on such a roughened and more porous surface of enamel, lactic acid underneath the plaques more readily passes into the tissue, and thus decay is hastened.

Most persons who buy tooth-cleaning fluids cannot afford the service of a dentist to clean their teeth. Usually they are also youthful individuals who take a special pride in their personal appearance. But during youth, when caries is most rampant, the use of such acid tooth-cleaning fluids creates the greatest havoc by still further increasing the liability to dental decay.

B. CHEMICAL FINDINGS

MAXWELL KARSHAN, M.A., PH.D.

Laboratory of Biological Chemistry, College of Physicians and Surgeons, Columbia University, New York City

In a chemical study of *Bleachodent*, *Ekay*, *Ex-Tartar*, and *Tartar-off*, the nature and degree of their acidity were ascertained. The solvent action of these fluids on enamel was also studied. The titratable acidity was determined by neutralizing 2 cc. of fluid with 0.1*N* NaOH, using as indicators methyl orange and phenolphthalein. The

kind of acid present was established by ordinary qualitative tests. The solvent action on enamel was studied by immersing the crown of a human tooth, the root of which was embedded in wax, in 1 cc. of fluid, upon which conventional tests for dissolved calcium and phosphorus were then performed.

Bleachodent

The acids present are HCl and H_2SO_4. Ammonium salts, probably as the chloride and sulphate, are also contained in the fluid. Two cubic centimeters required for neutralization 5.3 cc. of 0.1 *N* NaOH with phenolphthalein as indicator; 4.5 cc. with methyl orange. The abnormal value obtained with phenolphthalein is due to the contained ammonium salts. Calculating the normality from the methyl orange titration, the fluid is found to be 0.23 *N*, and the percentage, expressed as HCl, is 0.83; or, as H_2SO_4, 1.12.

A *chloride* determination indicated the presence of 1.5 per cent chloride. If HCl is calculated from this figure, a percentage of 1.55 is obtained, whereas from the titration figure the maximum percentage of HCl that can be present is 0.83. This indicates the presence of a chloride, presumably of ammonium. The *sulphate* content was found to be 2.55 per cent. This quantity of sulphate is found in 2.6 per cent solution of H_2SO_4. Since, from the titration figure, the maximum percentage of H_2SO_4 that might be present is 1.12, it is evident that sulphate was introduced into this fluid as a salt, presumably as ammonium sulphate. The amount of *ammonium* present, expressed as NH_3, was 1.02 percent. This amount exceeds the quantity that could be present as chloride or sulphate.

Ten seconds of contact of a tooth crown with a portion of the fluid was sufficient to dissolve enough calcium and phosphorus from the enamel to give striking tests for these substances.

Ekay

The acid present is HCl. Two cc. required for neutralization 2.6 cc. of 0.1 *N* NaOH, representing an acidity of 0.13 *N* and a percentage, expressed as HCl, of 0.47. This result corresponds exactly with the

percentage of HCl calculated from a chloride determination, indicating that the only acid present is HCl.

Ten seconds of contact of a tooth crown with a portion of the fluid was sufficient to dissolve enough calcium and phosphorus from the enamel to give striking tests for these substances.

Ex-Tartar

A weakly ionized acid is present, which could not be identified because only a few cc. of this fluid were available. That the acid is of this nature was concluded from the titration values with different indicators.

Two cc. of the fluid required for neutralization 17.6 cc. of 0.1 *N* NaOH when methyl orange was used as the indicator; 29.7 cc., with phenolphthalein. This is a typical result of titration of weakly dissociated acids with strong bases, the methyl-orange figure being abnormal. Therefore, calculating the normality from the phenolphthalein titration, the acidity of the fluid is 1.5 *N*.

In order to obtain positive tests for dissolved calcium and phosphorus, thirty seconds of contact of a tooth crown with a portion of the fluid were necessary.

Tartaroff

The acid present is HCl, which has been noted by others.[5] Some of the effects of this fluid on teeth have already been reported.[6] Two cc. required for neutralization 8.6 cc. of 0.1 *N* NaOH, representing an acidity of 0.43 *N*, and a percentage, expressed as HCl, of 1.5.

The chloride content was determined, and the percentage of HCl calculated from this figure. This result corresponds exactly with the percentage calculated from the titration figure, indicating that HCl is the only acid present.

Ten seconds of contact of a tooth crown with a portion of the fluid

[5] Bureau of Chemistry; Tartaroff; A "tartar-remover;" *Journal of the American Dental Association*, 1928, xv, p. 2167.

[6] Bureau of Chemistry; Helping the A.D.A. Bureau of Chemistry to help the public; *Journal of the American Dental Association*, 1930, xvii, p. 344.

was sufficient to dissolve enough calcium and phosphorus from the enamel to give striking tests for these substances.

TABLE 1

*Summary of chemical data pertaining to some so-called tooth-cleaning fluids**

FLUID	ACID PRESENT	ACIDITY		
		NaOH (0.1 *N*) required to neutralize 2 cc. of fluid	Calculated normality	Expressed as HCl
		cc.	*N*	*Per cent*
Bleachodent	HCl and H_2SO_4	4.5	0.23	0.83
Ekay	HCl	2.6	0.13	0.47
Ex-Tartar	A weakly ionized acid	29.7	1.5	....
Tartaroff	HCl	8.6	0.43	1.5

* Efforts to obtain in the open market additional supplies of Snovy-White, to supplement the histological findings, were unsuccessful.

Quotations Relating to "Dentistry or Stomatology"

THIS JOURNAL uses the term "dentistry" to signify the science and art of oral health service in all its local and systemic relationships. The meanings of words, which are not necessarily restricted to *etymological* significance, acquire expanded or new import in accordance with convenience and usage. Thus the term "medicine," which originally meant to remedy or cure, now also means *to make remedial or curative treatment unnecessary.* "Stomatology" is a synonym for "dentistry." We prefer the older term because its use respects both the history of dentistry and the efforts of those who have brought dentistry to its present status.—*Journal of Dental Research*, 1929, ix, p. iii.

If dentistry were merely dental mechanics, a two-year course in dental technology, based on graduation from a high school and conducted along lines similar to those for the education of optometrists, would probably afford sufficient training for dental practice, and oral health-service could be reserved for a new specialty to include oral surgery, which might be named stomatology and made analogous to ophthalmology and other specialties of medicine. But with dentistry developed into the *full service equivalence* of an oral specialty of medicine, the creation of a medical specialty of stomatology would be redundant—and there would be no occasion to substitute "stomatology" for the name established by custom.—*Carnegie Foundation's Bulletin on Dental Education*, 1926, p. 135.

The assumption that dentistry would be something more or better than it is, if all or a part of it were called "stomatology," exemplifies a readiness to attach more importance to labels than to contents, or more significance to make-believe than to reality. The term "medicine" originally meant to remedy or cure. ["*Medicina* (ars)"—healing art; "*medicina* (res)"—a remedy; "*medicus*"—of healing; also a physician.] Today "medicine," by including measures to *prevent* sickness and by throwing *etymology* overboard, means not only to remedy or cure, but also *quite the contrary*—to make remedial or curative treatment unnecessary. As medical knowledge has advanced and medical procedures have been changed in consonance, including the development of prevention and of surgery, new meanings have been imparted to the term "medicine." But instead of replacing "medicine" by a succession of words intended to indicate *etymologically* the broader or deeper modern meanings, the import of the original term has been conveniently enlarged as the scope of medical practice has expanded. Thus, the term "medicine" has come to mean more and more as *physicians*, without restricting themselves to its *etymology*, have included *more and more in its significance.* Along the same line of reasoning one sees clearly that, although *etymologically* the term "dentistry" refers only to the teeth, nevertheless logically it also comprehends the contiguous parts and their systemic relationships. Certainly by *usage* in conformity with this logic, and also with the criteria of common sense, the term "dentistry" has *acquired* the broader meaning suggested by the more detailed and lengthy term "oral health-service." By logic, usage, and convenience, the term "dentistry" has thus become the *practical* equivalent of "stomatology," which *etymologically* means the sum of scientific knowledge concerning the mouth, but *etymologically does not include the rest of the body* (although "stomatology" is now *used* by some to include systemic relationships with the mouth). This being true, we are unable to agree that "dentistry" and "dentists," which are terms that have long represented the earnest and aspiring endeavors of generations of faithful practitioners of oral health-service, should be formally replaced for *etymological* reasons by "stomatology" and "stomatologists."—*American College of Dentists*, March, 1929.

The New York Academy of Dentistry . . . without any diminution of its abiding purpose to promote intimate association and cooperation between dentists and the practitioners of all other kinds of health-service, believes that, in the interest of the patient, dentistry should be *continued* as a separately organized profession, based on systems of ethics, education, jurisprudence, and journalism that will fully meet all public needs at each stage of its evolution.—*New York Academy of Dentistry, April, 1929.*

The Dental Society of the State of New York . . . expresses the earnest conviction . . . that the most effectual development of oral health-service will be insured by the *continuance* of dentistry as a separately organized profession . . . [and] also records its unabated desire and intention to promote personal and professional accord, cooperation, and mutual helpfulness between dentists and the practitioners of medicine and all other kinds of health-service.—*Dental Society of the State of New York, May, 1929.*

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